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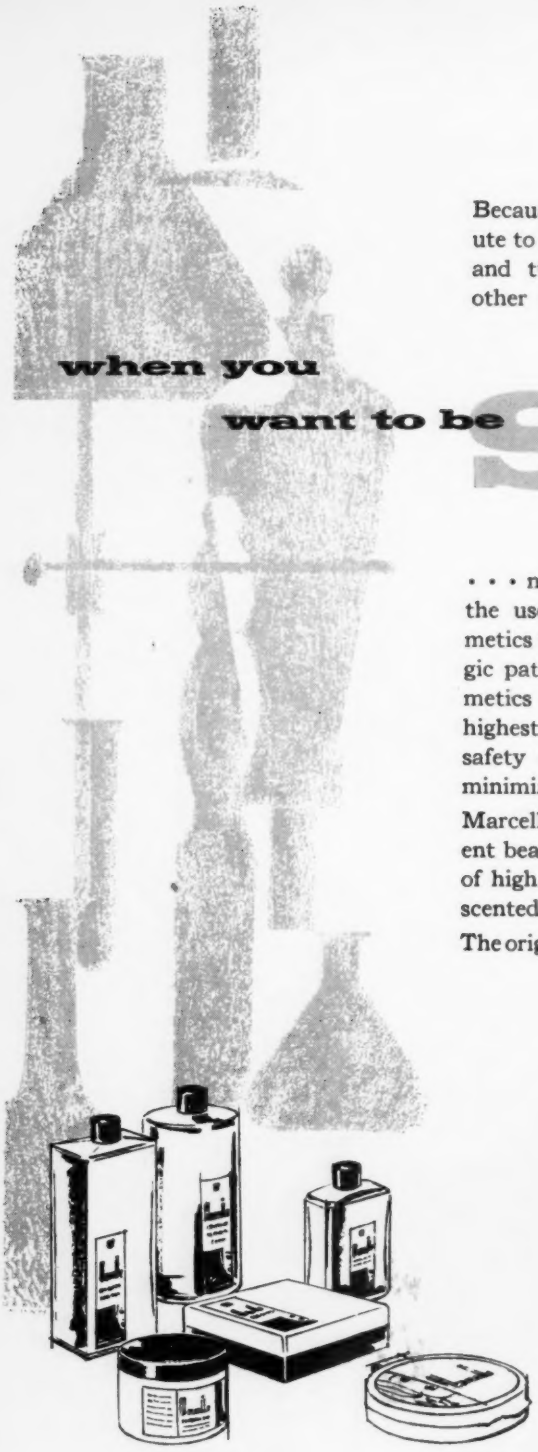

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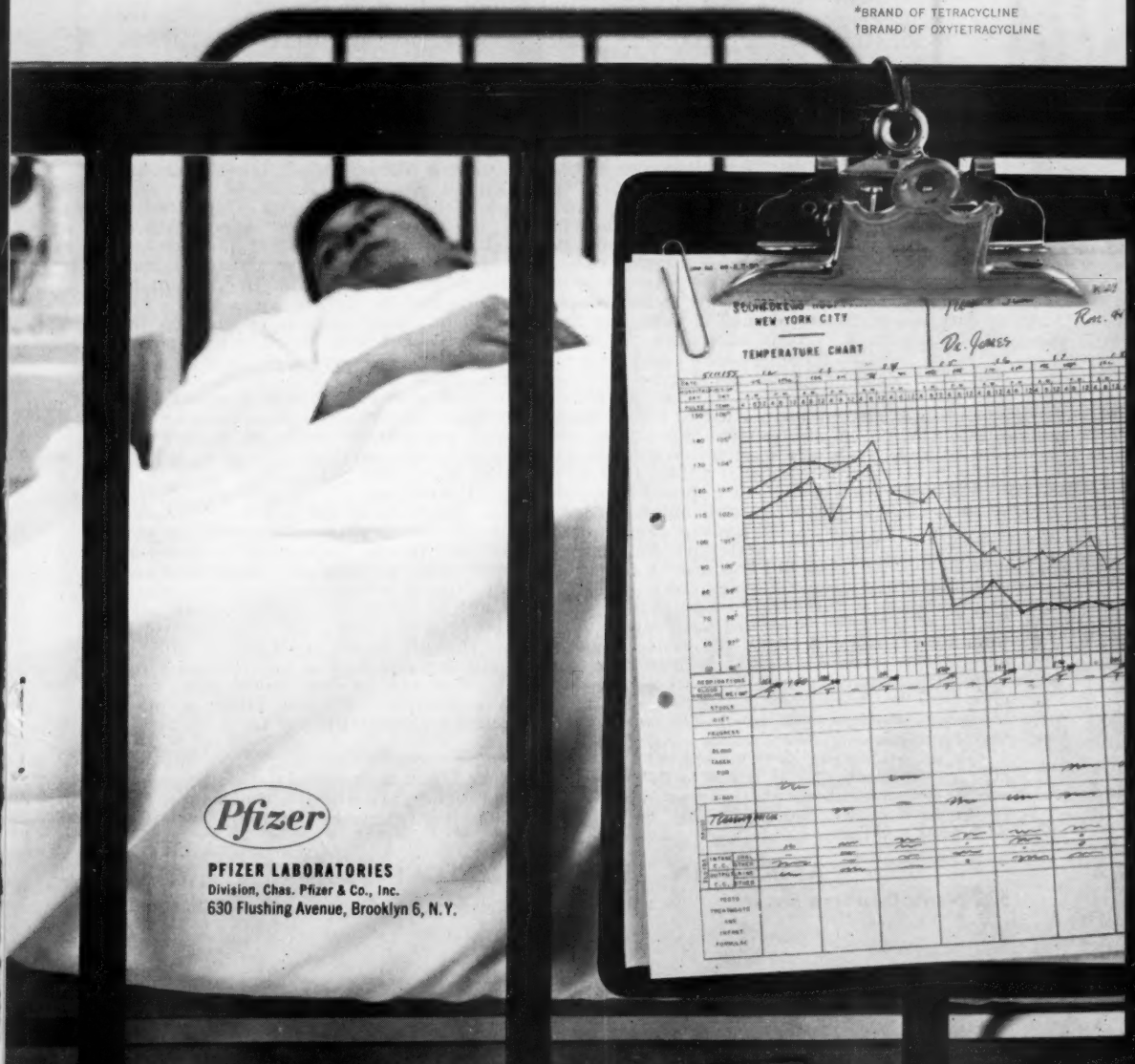

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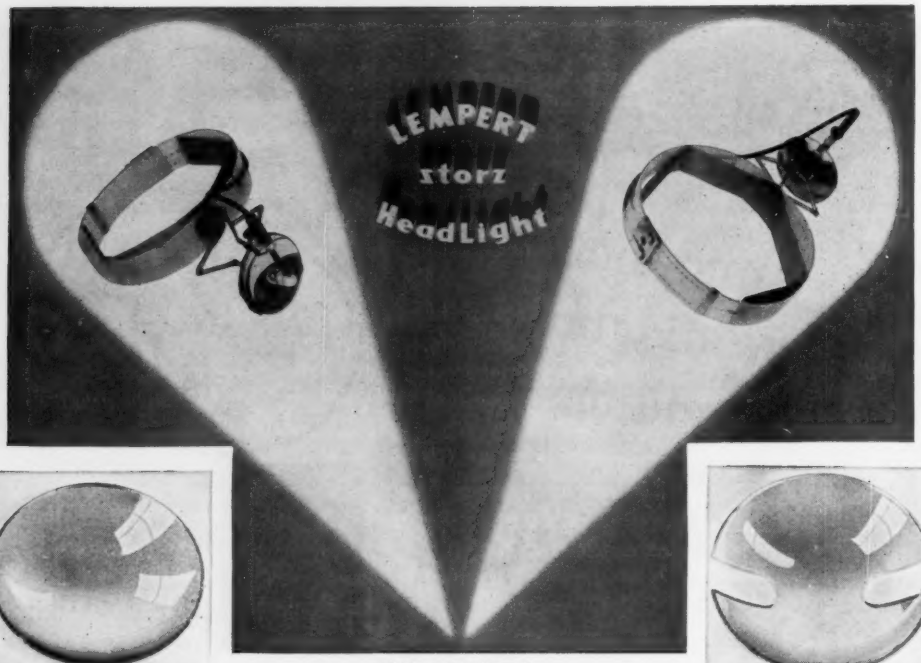

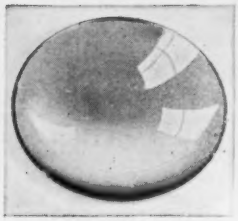

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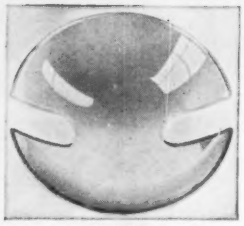

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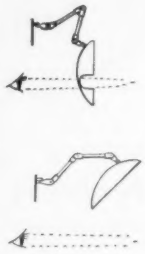

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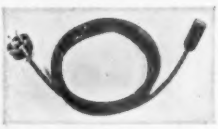

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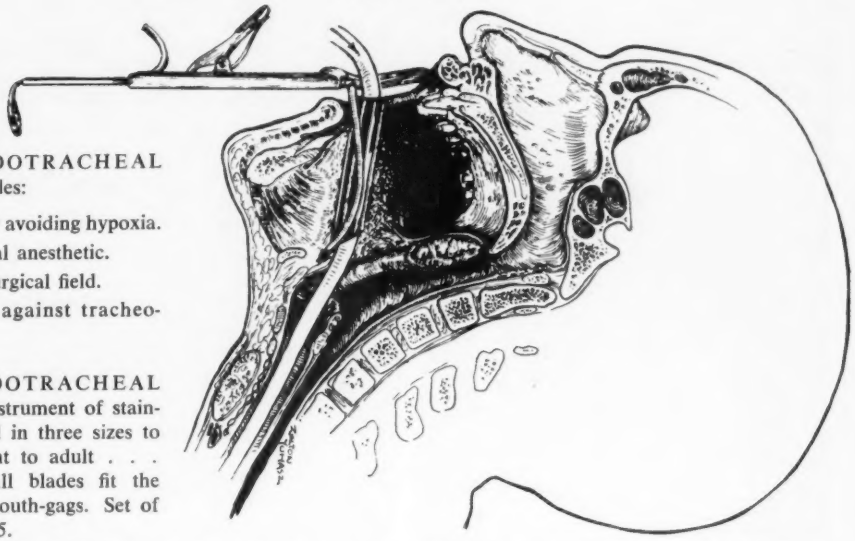

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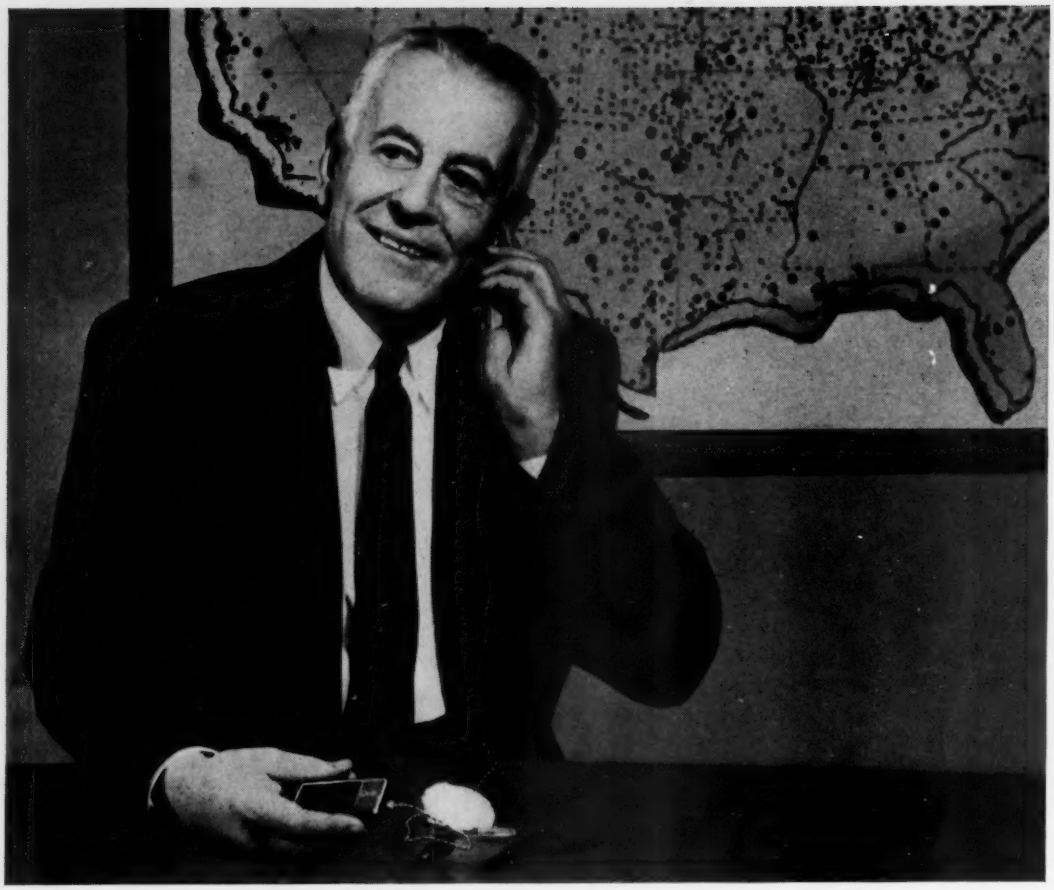

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Rare Tuberculous Lesions Treated with Streptomycin

H. OPPENHEIM, M.D., Louisville

Streptomycin and dihydrostreptomycin, with or without paraaminosalicylic acid (PAS), have revolutionized the treatment of tuberculosis, particularly in the field of otolaryngology. Sufficient favorable experience with these antibiotics has been accumulated in patients suffering from laryngeal or bronchial tuberculosis. Similar, if slightly less successful, results have been achieved in tuberculosis of the middle ear and pharynx.

There remain some areas within our specialty where tuberculosis appears so infrequently that it becomes nearly impossible for a single observer to render a conclusive opinion regarding the therapeutic results obtained. It is the purpose of this paper to contribute to the scant literature existing on tuberculosis involving the maxillary sinus or the lip and tongue. At the same time the effects of streptomycin therapy, with or without PAS, in these lesions are recorded.

A. TUBERCULOSIS OF THE MAXILLARY SINUS

Purulent paranasal sinusitis of nonspecific origin occurs fairly frequently in the presence of pulmonary tuberculosis. Statistical data on this subject, based upon autopsy material, vary with different authors from an incidence of 10%-49%.* (In the last instance, examinations were limited to the maxillary sinus exclusively.)

On the other hand, most investigators are in agreement that clinical tuberculosis of the paranasal sinuses constitutes a most unusual finding.† Myerson[69] states: "Tuberculosis of the paranasal sinuses is so rare that it is not mentioned in most textbooks." The same author observed only a single patient suffering from this condition during a five-year period at a large tuberculosis hospital. St. Clair Thomson and Negus[91] discuss the subject in three lines.

The maxillary antrum is by far the most frequent seat of tuberculous infection of the paranasal sinuses which may become clinically involved. Gleitsmann,[32] in 1907, collected 20 cases of tuberculous maxillary sinusitis from the world literature. Hersh,[38] in 1938, was able to add seven more cases, including his own. Radner and Pinkerton,[77] in 1944, published a case of tuberculosis involving both maxillary antra. In 1948, a case of tuberculous maxillary sinusitis was reported by Hara and Crane,[36] to which reference will be made later. Hore and Kirchenberger[42] followed in 1949 with a case involving the antrum and ethmoid labyrinth.

Submitted for publication Feb. 21, 1955.

Presented as a candidate's thesis in partial fulfillment of the requirements for membership in the American Laryngological, Rhinological and Otological Society, Inc.

* References 22, 28, 49, 60, 73, and 97. Vernieuwe: Contribution a l'étude de la tuberculose des sinus de la face, cited by Fallas.[24]

† References 23, 24, 29, 35, 41, and 47. Zarniko: Krankheiten der Nase und des Nasenrachens, cited by Fallas.[24]

Hoogenhuyze and deKleyn [41] described two cases in which a tuberculous process of the ethmoid sinus penetrated into the maxillary antrum. However, tuberculous changes in that cavity could not be demonstrated in either insance. Two similar patients were observed by Dörner [28] and Frey,[29] respectively. Panse's [76] case affected the maxillary and sphenoid sinuses. Tuberculous pansinusitis was reported in several persons by Lederer and Livingston,[51] Levy,[52] and Lockard.[53]

Therefore, up to 1949, a total of about 30 instances of tuberculosis involving the maxillary antrum alone were published. Since that time only one additional case of maxillary sinusitis of tuberculous origin seems to have appeared in the literature.[31] The paucity of tuberculous involvement of the antrum may justify the reporting of such a case. Furthermore, this patient represents, to my knowledge, the third published instance of a person treated with streptomycin for this disease, and the first one observed over a period of more than three years.

Tuberculosis of the maxillary sinus attacks men more frequently than women. No age escapes the disease. While most cases occur in adults, there exists an interesting report of tuberculosis of the maxillary bone and its sinus in an infant.[2]

Instances of alleged primary tuberculosis of the paranasal sinuses have been reported by Coakley,[15] Demme,[21] Finder,[26] Frey,[29] Gaudier,[30] Gibson,[31] Keckwick,[47] Neufeld,[70] and Vernieuwe.‡ However, there still exists some controversy as to their primary origin. The majority of cases of tuberculous sinusitis develop secondary to a pulmonary or an extrapulmonary focus.§ Mill [59] observed tuberculous maxillary sinusitis in the presence of tuberculous laryngitis.

Direct extension from neighboring organs or implantation of bacilli by way of the blood stream accounts for the majority of tuberculous lesions in the antrum. Tuberculous sinusitis resulted subsequent to a tuberculous process of the nose or of the maxillary bone in 12 out of 20 cases collected by Gleitsmann.[32] A similar report appeared in 1951.[105] A number of cases have been described in which tuberculous involvement of a tooth socket was followed by a breakthrough into the maxillary sinus.‖ The molar and premolar regions were the favorite sites of the perforations. Antral tuberculosis by extension from the eye or the nasolacrimal passages is apparently unknown.

Gross pathological changes found in tuberculosis of the maxillary sinus may be divided into three groups:

In the first group, only the mucosal layer is involved. The sinus is filled with thickened mucosa and often with polypoid tissue. Granulations are usually found, with or without pus formation, in the antrum. Tubercle bacilli cannot always be demonstrated in the secretions obtained by antral puncture.¶ The diagnosis of this type is, as a rule, only possible by histologic examination of tissue removed by operation or biopsy. Even then, foreign-body reactions in the mucosa of the sinus must be excluded.[83]

The second group is manifested by additional involvement of the surrounding bone, in the presence of caseation, fistulae, or sequestra.

The third group is represented by the tuberculoma. It is of extremely rare occurrence. Only a single case of this type has been described.[34]

The histologic features of tuberculous lesions are too well known to be mentioned here. They may be found in some of the ensuing case reports.

The diagnosis can sometimes be determined by isolation of the tubercle bacilli from the antral washings. The tuberculous nature of the disease becomes established by histologic examination of tissues removed at operation. The possibility of syphilis or a

‡ Vernieuwe: Contribution a l'étude de la tuberculose des sinus de la face, cited by Fallas.[24]

§ References 33, 48, 56, and 101.

‖ References 10, 17, 18, 21, 70, 71, 81, 82, and 96. Brindle, and Koschier, cited by Fallas.[24]

¶ References 31 and 47.

malignant growth may be excluded by these procedures.

The symptoms of tuberculous sinusitis depend on the site and the extent of the disease. Mucoid or purulent discharge, postnasal drip, and nasal obstruction, with or without anosmia, are early signs. As the disease progresses, there appear nosebleeds, nausea, and vertigo, together with headaches, local pain, and signs of involvement of neighboring organs. Complications arise with the invasion of important structures. They range from lacrimation and swelling of the eyelids to blindness and meningitis.

The prognosis is guarded, but appears to be somewhat better in cases where the disease is limited to the mucous membrane. Heretofore most cases with bone involvement ended fatally. The general outlook is influenced by the status of the disease elsewhere in the body.

Most authors consider surgery the only promising therapy for tuberculous sinusitis. Several radical operations on the sinuses involved have been performed, with gratifying results. Surgery of the maxillary antrum offers a better hope for cure than operations on other sinuses. Iodoform and chaulmoogra oil have been used, with satisfactory results, postoperatively.[45]

Streptomycin or dihydrostreptomycin, with or without PAS, in addition to surgical procedures, may prove to be of distinct benefit, particularly in cases of predominantly mucosal involvement. Only two reports regarding the use of these antibiotics in tuberculous sinusitis could be found in the literature.# The first patient died of heart disease after four months' observation.[36] The other one was cured 19 months after surgery and a course of 3.0 gm. of streptomycin weekly, injected intramuscularly for a period of 13 weeks.[31]

CASE 1.—J. F. L., a 30-year-old white man, suffered from pulmonary tuberculosis of the reinfection type in October, 1949. Chest x-rays revealed bilateral upper lobe disease, with cavitation in the right lung. The sputum was positive for tubercle bacilli. Right artificial pneumothorax was begun in January, 1950, and followed by a right pneumonolysis in July, 1950. All sputa, with the exception of a gastric culture in April, 1950, became negative for tubercle bacilli.

In January, 1951, the patient complained of severe right supraorbital headaches radiating into the right neck. In addition, for the first time since April, 1950, concentrated sputa became positive for tubercle bacilli, in spite of the stabilization of the pulmonary disease. Transillumination and x-rays of the paranasal sinuses revealed cloudiness of the right maxillary antrum. In January and again in February, 1951, punctures of the right antrum produced 10 cc. of yellow creamy pus on each occasion. Both specimens were positive for tubercle bacilli by culture and guinea-pig inoculation. These organisms were sensitive to 3γ of streptomycin. X-rays of the right maxillary antrum after injection with iodized oil (Lipiodol) showed marked thickening of the mucous membrane.

A right nasoantral window was created in February, 1951. Examination of the antral mucosa removed through this window by curettage originally showed only inflammatory tissue. In May, 1951, a right Caldwell-Luc operation was performed. Purplish granulation tissue in the medial superior corner of the antrum was removed. Histologic examination of this tissue revealed tuberculosis.

The patient received 1.0 gm. of streptomycin intramuscularly daily without PAS. From that time on, all sputa remained consistently negative for acid-fast bacilli. The patient lost his headaches and gained weight. He was discharged with the disease apparently arrested, and has remained without complaints for more than three years.

Comment.—In view of the absence of tubercle bacilli in the sputum for over eight months previous to the diagnosis of sinusitis, it appears reasonable to ascribe the sudden reappearance of sputum positive for tubercle bacilli to drainage originating in the right maxillary antrum. Furthermore, no positive sputum (by culture or gastric lavage) has been obtained since the institution of streptomycin therapy after operation. The question whether either the Caldwell-Luc procedure or streptomycin alone could have produced the same results cannot be answered definitely. It is believed, however, that streptomycin was helpful in preventing or arresting a future spread of the disease into the surrounding structures.

References 31 and 36.

B. TUBERCULOSIS INVOLVING THE LIP AND TONGUE

Oral tuberculosis is a comparatively uncommon disease, in spite of the poor hygiene prevailing in the mouths of many patients suffering from tuberculosis.* Various theories explaining this rarity have been formulated: the resistance of thickened epithelium to invading organisms; the protective and germicidal action of saliva; the rich blood supply of the region; the constant movement of the tongue and cheek, preventing prolonged contact with the bacilli; the antagonistic action of various bacteria among themselves.

The different aspects of oral tuberculosis and its therapy have recently been discussed in some detail.† They are omitted here, except for specific lesions of the lip and tongue.

Reviewing the literature in 1915, Carmody [12] found among 661 tuberculous lesions of the mouth 48 on the lips and 277 on the tongue. He stated that in oral tuberculosis the lips are infrequently involved. Tuberculous lesions of the lips are exceeded in rarity only by those of the hard palate and salivary glands. But McPherson and Gregg,[57] adding a case in 1924, remark that a tuberculous ulcer of the lip is perhaps the rarest form of all types of oral tuberculosis. Ivy and Appleton [44] reported three cases of tuberculosis of the gums, one of which spread to the lower lip. In 1927, Rubin [84] collected 72 cases of tuberculosis involving the buccal membranes. Of these, 6 were located on the lips and 16 on the tongue. Stahler [90] was able to find 30 reports of solitary or primary tuberculosis of the lip up to 1938. Discussing two cases in detail, he emphasizes the variation of clinical characteristics and demonstrates the impossibility of diagnosing the disease without biopsy. He also quotes an internist who had never seen tuberculosis of the lip in 20,000 patients suffering from pulmonary tuberculosis. Shengold and Sheingold [89] found 4 cases on the lips and 4 on the tongue among 20 tuberculous lesions of the mouth. One case each of tuberculosis of the lip was reported in 1950,[72] 1952,[106] and 1953,[13] respectively. Altogether about 90 cases of labial tuberculosis have been recorded.

Tuberculosis of the tongue, although not as rare as tuberculosis of the lip, is uncommon. Less than 500 cases have been reported, but more statistical data are available for lesions in this location than for tuberculosis of the lips. The tongue, among all organs of the oral cavity, is most frequently the seat of a tuberculous infection. From 46%-63.3% of all tuberculous lesions of the mouth are located in the tongue.[5]

According to Morrow and Miller,[67] Morgagni described lingual "tubercles" in 1761, but the first authentic case of tuberculosis of the tongue was reported by Portal in 1804. The first autopsy case was published by Virchow in 1864 (cited by Farber and associates [25]).

Willigk [99] found 2 cases of lingual tuberculosis among 1317 patients (0.15%). D'Aunoy and associates [19] state that among 730,524 admissions, 24,548 of which were for tuberculosis, only 5 cases of lingual tuberculosis were encountered within 29 years. Up to 1937, they could find only 357 cases of lingual tuberculosis reported in the literature. Bryant [8] discovered 9 cases (0.13%) in 7000 patients suffering from far-advanced pulmonary tuberculosis. Myerson [69] found 31 cases of lingual tuberculosis among 9735 tuberculous patients (0.32%). Thirty cases (0.37%) occurring in 8204 admissions were reported by Titche [93] in 1945. Motta and Novak [68] published 10 cases in 1949. Zmajevich [103] saw only 1 case of lingual tuberculosis among 12,369 patients, but he observed 5 cases among 1500 tuberculous patients (0.33%).

Castigliano and Shigeoka [18] found only eight cases of proved tuberculosis of the oral cavity from 1909 to 1950. Five of these eight cases involved the tongue. During the same period of time about 2200 cases of intraoral epidermoid carcinoma came under their care.

Until 1941, about 400 cases of lingual tuberculosis had been published, but only 35

* References 14 and 84.

† References 13, 72, and 89.

had been autopsied.‡ In 141 consecutive autopsies 28 cases (19.9%) of tuberculosis of the tongue were found.[46] At autopsy, lingual tuberculosis is therefore much more frequently encountered than clinically. This fact was also pointed out by Canuyt.[11]

As to the location of tuberculous lesions of the tongue, Carmody [12] indicated the following order of frequency: tip, border, dorsum, base. The location on the dorsum of the tongue was most frequently found by Valtan.[95] Katz [46] saw the majority of the lesions on the base. According to Brodsky,[6] the dorsum or lateral border is the most usual seat of the disease. But Titche [93] remarked that there seems to be no definite site or predilection, although the lateral margins and the tip of the tongue appear to be most commonly involved by the disease.

Nearly all tuberculous lesions of the tongue are found in white males. Only very few cases seem to have occurred in Negroes. The incidence of the disease is about three times as great in the male as in the female.§ According to others,‖ the ratio is six to one.

Some authors found the majority of their cases to occur in the second and third decades.¶ Others encountered the largest number in the fourth decade.#

With a few exceptions,* most investigators agree that oral tuberculosis always occurs secondary to disease of the lung or an extrapulmonary focus.† Tubercle bacilli from a primary lesion may reach the tongue and lips by four theoretical ways: by actual contact, by direct extension, by the blood stream, and by the lymphatics. Ornstein [74] favors the hematogenous route, because experience has shown that oral tuberculosis occurs infrequently in the presence of pulmonary tuberculosis with sputum heavily laden with bacilli. Conversely, there is evidence that oral tuberculosis prevails in the presence of pulmonary tuberculosis in which there is difficulty in demonstrating bacilli in the sputum.

According to Brodsky,[7] tuberculosis of the tongue assumes the following forms: ulcer, fissure, granuloma, tuberculoma, and glossitis. Ulceration is by far the commonest and also the severest type.[37] The ulcers show an irregular outline, undermined edges, and frequently are covered with a grayish exudate. No induration is present, in contrast to cancerous lesions. The commonest complaint consists in painful deglutition, particularly if the disease assumes the form of an ulceration.

The lesions must be differentiated from those of syphilis and malignant growths.[102] For obvious reasons, a lesion on the lip or tongue cannot be considered to be tuberculous in nature merely because of the presence of sputum positive for tubercle bacilli. Therefore a biopsy should always be performed.

The prognosis of tuberculous lesions of the lip and tongue heretofore has been poor, especially in the presence of ulceration. Granuloma gave a somewhat better outlook. Once established, the lesions develop independently of the progress of the pulmonary disease.

The conventional treatment of tuberculosis formerly employed was unsatisfactory because it afforded only palliation. By topical application of caustics or the direct cautery,‡ as well as by surgery,§ it was hoped to obtain the destruction of the localized lesion, thereby sterilizing it and preventing its spread. Obviously, the beneficial effects were questionable.[40] Ultraviolet or cold quartz lamp rays, radium or roentgen irradiation, especially in the form of grenz rays, have been used with more or less success, as has been the case with tuberculin therapy. In terminal cases local anesthetics have been employed. Infiltration or even resection of

‡ References 46 and 86.
§ References 75 and 84.
‖ References 55 and 89.
¶ References 46 and 67.
# References 3, 20, 25, 27, and 93.
* References 54, 55, and 94.
† References 9, 50, 69, 74, and 75.

‡ Carmody, T. E., in discussion on Ivy and Appleton.[44]

§ References 78 and 94.

the lingual nerve has occasionally become necessary in order to control the pain.

Because of the inadequacy of these methods, the introduction of streptomycin and dihydrostreptomycin was most welcome. The respective advantages and disadvantages of these two antibiotics have become well established. Topical application of these drugs was abandoned as unsatisfactory.‖ Therefore, in the patients reported here, the intramuscular route of therapy was used exclusively. The large and frequent dosage originally employed has given way to the administration of 0.5 to 1.0 gm. daily or twice weekly. It is a recognized fact that streptomycin may cause vestibular disturbances in prolonged use; dihydrostreptomycin has a greater propensity for damaging the auditory nerve.

During the past few years it has become customary to administer streptomycin (or dihydrostreptomycin) intramuscularly together with oral doses of PAS. Combination with this drug not only renders effective the administration of either antibiotic for longer periods but probably also permits repeated effective courses. The emergence of drug-resistant strains becomes delayed and less frequent by the addition of PAS to streptomycin or dihydrostreptomycin.[1] The pronounced synergistic action of streptomycin and dihydrostreptomycin has become confirmed.[43] One-fourth of the normal bacteriostatic dose of each drug in combined administration produces the same effect as the normal dose of either drug given alone.[16]

In view of the rare incidence of labial and lingual tuberculosis, it is not surprising that there exist only a few reports of the use of streptomycin or dihydrostreptomycin, with or without PAS, in the treatment of these conditions. Therapy with these antibiotics in tuberculosis of the lip seems to have been reported only in one single case.[72] This particular patient received a daily dose of 1.0 gm. of dihydrostreptomycin intramuscularly combined with 12.0 gm. of PAS orally. Four weeks later the ulcer on the lip had healed completely, and remained so from that time on.

A few more reports on the effect of these antibiotics in lingual tuberculosis exist in the literature. Shamaskin[88] treated three patients with lingual tuberculosis in 1947. One of these, receiving 2.0 gm. of streptomycin intramuscularly daily, remained healed after 60 days of therapy. His second patient was treated unsuccessfully with 0.5 gm. of streptomycin by daily topical application. He then received 2.0 gm. of streptomycin daily by intramuscular injection for 100 days, with great improvement; however, a relapse occurred, the ulcer reassuming nearly its original size. The third patient received combined therapy with streptomycin, 0.5 gm. topically and 2.0 gm. intramuscularly daily. The lingual ulcers had been present for five years. After 60 days, treatment with streptomycin was abandoned because the lesions did not respond and the patient's condition continued to deteriorate.

Wolfer and associates[100] cured an ulcerative lesion in the central part of the lingual dorsum in 1948. Their patient, after the discontinuation of unsuccessful therapy by local infiltration with the drug, received a total of 75.0 gm. of streptomycin intramuscularly in daily doses of 1.0 gm. A similar case was reported in 1949.[85] Three other cases of lingual tuberculosis (two on the margin, one in the middle of the posterior half of the tongue) appeared in the literature in 1950.[72] In the first case, the ulcer healed within 10 days under treatment with 0.5 gm. of streptomycin intramuscularly twice daily; but it returned one and one-half years later, and was then successfully treated with 1.0 gm. of streptomycin intramuscularly daily for 44 days. The lesions of the second and third patients remained healed after 1.0 gm. of streptomycin had been given intramuscularly daily for three and four weeks, respectively.

Melega[58] treated two out of three patients with lingual tuberculosis successfully with 0.5 gm. of streptomycin twice daily combined with PAS orally. Two other patients

‖ References 61 to 66.

were cured by Levinsky.[104] The total dosage of streptomycin given was 22.0 gm. and 30.0 gm., respectively. Castigliano and Shigeoka [13] observed a patient with tuberculous lesions on the dorsum and the left lateral border of the tongue. The lesions healed after two and one-half months' therapy with 0.5 gm. of streptomycin intramuscularly twice daily for a total of 25.0 gm.

A tuberculous ulcer of the lingual dorsum was treated successfully by Wiese.[98] His patient received originally 0.25 gm. of streptomycin intramuscularly twice daily for six weeks, and thereafter the same dosage of streptomycin together with 12.0 gm. of PAS orally for 12 weeks. A tuberculoma of the tongue was treated similarly by Beales.[4]

In addition to the publication of the above individual cases, there appeared several summaries on streptomycin therapy in the transactions of the different Veterans Administration Streptomycin Conferences.¶ Only at the fourth conference,[62] however, was lingual tuberculosis specified. Of 11 cases, 6 healed, 4 improved, and 1 case was unchanged under streptomycin therapy. At the third conference,[61] eight cases involving the tongue and tonsils were discussed together. At the later conferences,# differentiation between lip or tongue disease became impossible, because these lesions were grouped together as oropharyngeal tuberculosis. By the time of the ninth conference,[66] a total of 140 cases of oropharyngeal tuberculosis had been collected. Of these, 70% were cured, 22% improved, 6% unchanged, 2% were worse, and 4% relapsed later, after cure or improvement.

If we estimate with Binstok [5] and Carmody [12] that in about 50% of the cases of oral tuberculosis the tongue is involved, we may assume that streptomycin therapy in lingual tuberculosis has been employed in about 80 individual patients.

CASE 2.—F. B., a 56-year-old white man, was suffering from a moderately advanced bilateral pulmonary tuberculosis of the reinfection type when first seen in 1949. In October, 1950, the patient complained of a small itching pimple on his right upper lip. He stated that this lesion had existed for months, usually with slight discomfort. Off and on it became macerated, without disappearing completely. Examination showed a small, papular growth with a minute central ulceration on the skin adjoining the vermillion border of the right upper lip. In order to ascertain the nature of this lesion, a biopsy was performed and cultures for fungi were taken. The histological diagnosis was tuberculosis.

The patient received daily 1.0 gm. of streptomycin intramuscularly and 12.0 gm. of PAS orally for 48 days. The lesion on the lip was completely healed after four weeks' therapy, and remained so when seen three and one-half years later. His pulmonary tuberculosis remained essentially unchanged with an occasional sputum positive for tubercle bacilli.

CASE 3.—C. H., a 60-year-old white man, was admitted for far-advanced pulmonary tuberculosis of the reinfection type, with bilateral fibroulcerative lesions. His sputum was positive for tubercle bacilli. Examination in March, 1951, revealed two small papular lesions with central ulcerations inside the vermillion border on the upper lip, near the right angle of the mouth. In addition, there was an ulcerative lesion, covered with grayish exudate, on the left margin of the anterior third of the tongue. Biopsy specimens were taken from all three lesions. They showed tuberculosis of the lip and tongue, manifested by scattered tubercles, with giant cells, tuberculous granulation tissue, and a fair amount of caseation necrosis. Twenty-eight days' treatment was given with a daily dose of 1.0 gm. of streptomycin intramuscularly and 12.0 gm. of PAS orally. All lesions had healed within that period. The patient has been observed for three and one-half years since that therapy, without recurrence of the oral manifestations of tuberculosis. His pulmonary disease has improved.

CASE 4.—G. R., a 32-year-old white man, entered the hospital in April, 1953, with the diagnosis of far-advanced pulmonary tuberculosis of the reinfection type. Chest x-rays showed bilateral infiltration and cavitation. The patient had been treated intermittently for this disease since 1947, without ever completing a full course of therapy. Past treatment consisted in bed rest, a left pneumothorax, and streptomycin. His sputum was consistently positive for tubercle bacilli.

In March, 1953, the patient complained of soreness in the back of his tongue, aggravated by swallowing or by fluids. Gradually this area became tender and ulcerated. The patient stated that it had been rather painful for him to eat, which may account for his poor appetite and recent weight loss. His weight on admission was 80 lb. Examination

¶ References 61 to 66, 79, and 92.

References 63 to 66.

revealed an emaciated man with an ulceration about 3 by 8 mm. in size on the dorsum of the tongue in the posterior third. It presented a necrotic base, tender to touch. Histological examination of the biopsy specimen demonstrated a tuberculous ulcer. Therapy was begun in April, 1953, with 1.0 gm. of streptomycin intramuscularly twice weekly and 12.0 gm. of PAS daily by mouth. Within one week the temperature became normal and the patient felt better. The lingual ulcer cleared and filled in slowly with healthy granulation tissue. After five weeks the entire area was healed. Sensitivity tests showed the organisms to be sensitive to streptomycin and PAS in all test solutions. The patient's weight is increasing, but his pulmonary disease remains unchanged.

Comment on Cases 2, 3, and 4.—All three patients showed rapid healing of the tuberculous lesions on the lip and/or tongue within a period of five weeks. Their appetites and weights increased, because the pain on eating had disappeared. The lesions of Cases 2 and 3 remained healed after three and one-half years. The fourth patient has been observed for one and one-half years since therapy was started. There is no recurrence of his lingual ulcer. In none of the cases were the regional lymph nodes tender or swollen.

SUMMARY AND CONCLUSIONS

After a brief review of the essential literature, four cases of tuberculosis in rare locations are reported. One case showed involvement of the maxillary sinus. In the second patient the lesion was located on the upper lip. The third patient showed two ulcers on the upper lip together with involvement of the tongue on the opposite side. The lesion of the last patient was located on the back of the tongue. In all four patients the diagnosis of tuberculosis was proved by biopsy. All lesions appeared secondary to pulmonary tuberculosis. All four patients received streptomycin alone (Case 1) or in combination with paraaminosalicylic acid (PAS). The first three patients remained cured for three and one-half years. The lesion of the fourth patient has not recurred one and one-half years later.

Insufficient time has elapsed for final evaluation of the permanence of results obtained with streptomycin, with or without PAS, in rare tuberculous lesions, but it may safely be stated that these antibiotic drugs represent a simple and, up to now, the most effective therapeutic weapon against oral tuberculosis. Except possibly in the field of tuberculous paranasal sinusitis, surgical intervention may rarely become necessary. No reaction to the drugs occurred in these patients from the indicated dosage.

In this era of rapidly changing therapeutic concepts, the results obtained with streptomycin and PAS are recorded in the hope that further advantages in the treatment of tuberculous lesions may shortly become available. Recent reports * on the combination of streptomycin with isonicotinic acid hydrazide point in that direction.

Veterans Administration Hospital.

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Ligation of Both External Carotid Arteries for Control of Epistaxis

ARTHUR J. KUHN, M.D.
and
O. ERIK HALLBERG, M.D., Rochester, Minn.

Epistaxis is of such common occurrence that few persons pass through life without experiencing it. However, it may vary in severity from an insignificant to an exsanguinating volume.

The majority of nosebleeds probably require no medical care, and indeed are not brought to the attention of a physician. Of those that the physician does see, only a small proportion require more than simple measures for control. No accurate information is available on what proportion of nosebleeds seen by the physician are "severe," that is, require hospitalization, but it is estimated at less than 10%. The treatment of hospitalized patients who have nosebleed has been adequately presented elsewhere. Of Hallberg's series [1] of 212 such patients, 8.0% required arterial ligation for control. In Ogura and Senturia's series [2] of 136 hospitalized patients, including 48 children whose bleeding was in Little's area, 2.9% required arterial ligation (4.5% of the adults). In these cases the bleeding was so severe that it could not be controlled by less drastic measures, including anterior and posterior nasal packing, electrocautery, blood transfusion, and use of various local hemostatic agents. That such bleeding is potentially lethal is well known, and death may occur from exsanguination, exhaustion, cardiac complications, and other causes.*

The arterial blood supply to the nose has been reviewed frequently.† The important fact here is that this supply is from two major sources: (1) the internal carotid system through the anterior and posterior ethmoid arteries and (2) the external carotid system through branches of the sphenopalatine, superior labial, and descending palatine arteries. Most observers [7] describe the middle turbinate as the dividing line in the nose between these two systems of supply; that is, bleeding from above that structure originates in areas of ethmoidal supply, and bleeding from below it originates from areas supplied by the external carotid artery. These facts point to the rationale of the various procedures employed in arterial ligation for severe epistaxis.

There are four practical sites for arterial ligation in severe epistaxis: The first is the septal branch of the superior labial artery, in the anterior nasal floor.[9] Ligation at this site is rarely necessary, and bleeding from it is never a factor in potentially lethal hemorrhage. The second site is the anterior ethmoidal artery, along the medial wall of the orbit.‡ Ligation here has been shown to be valuable and even lifesaving. The posterior ethmoidal artery is usually very small and should not cause much trouble. The third site is the external carotid artery, in the neck, and usually between the lingual and superior thyroid

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Fellow in Otology, Laryngology and Rhinology, Mayo Foundation (Dr. Kuhn). From Section of Otolaryngology and Rhinology, Mayo Clinic and Mayo Foundation (Dr. Hallberg). The Mayo Foundation, Rochester, Minn., is a part of the Graduate School of the University of Minnesota.

* References 1, 3, and 4.

† References 2, 5 to 8.

‡ References 5, 7, 10, and 11.

branches.§ This is the commonest site, and numerous authors attest its value and effectiveness. The fourth site is the internal maxillary artery, in the pterygomaxillary fossa,‖ by a transantral approach. The indications for this are similar to those for ligation of the external carotid artery.

Ligation of the internal carotid or the common carotid artery or both for epistaxis is mentioned only to be condemned. The only indication for ligation of the internal carotid artery in nosebleed is hemorrhage into the nose from an aneurysm in the distribution of this vessel.¶ Simple ligation of the common carotid artery in this instance is not effective, because of retrograde flow down the external carotid and up the internal carotid artery, amounting to 50% of the normal flow.[20] In other instances of epistaxis, ligation of these vessels fails to accomplish anything that the simpler ligations do not accomplish, carries a significant mortality and morbidity in instances of recent hemorrhage,[21] and cannot be expected to control bleeding from the ethmoidal arteries because of their free anastomosis with the circle of Willis.#

Multiple ligations are occasionally necessary, usually involving the external carotid and anterior ethmoidal arteries of the same side. However, ligation of both external carotid arteries for epistaxis is apparently unusual. The only reference to such an instance is the brief mention of a case made by one of us (Hallberg).[1] We are reporting this case in detail here along with a recent case.

REPORT OF CASES

Case 1.—A 52-year-old man first came to the Mayo Clinic on Oct. 9, 1942, because of bleeding from both sides of the nose. The bleeding had been nearly constant for 10 days, and it had not been controlled with repeated packings of various kinds, use of local caustics and vasoconstrictors, blood transfusion, and surgical removal of some septal cartilage along the posterior margin of a large septal perforation (this perforation had followed a submucous resection performed at home 20 years previously). On arrival he was still oozing blood from both packed nostrils. Four days later the packs were carefully removed and there was no bleeding until a few hours later when profuse pulsating bleeding suddenly occurred. The blood seemed to come from the posterior edge of the perforation on the left. The bleeding could not be well controlled with packs; so, two days later, the left external carotid artery was ligated and the bleeding ceased. Nine days after ligation, an infection of the wound in the neck suddenly produced enough swelling to necessitate tracheotomy and drainage, but the infection rapidly subsided. The results of complete studies of the blood and of general examination were negative except for the loss of blood.

Seven months later the patient returned, having had recurrence of profuse epistaxis, from the right side, the day before. Again repeated nasal packings failed to stop the bleeding, which came from the anterior surface of the sphenoid on the right. Consequently, the right external carotid artery was ligated through the neck, again with complete control of bleeding. Five years later the patient had one further episode of nasal bleeding that was easily controlled with simple packing. There were no sequelae of arterial insufficiency to the nose, face, or mouth.

Case 2.—An 18-year-old woman came to the Mayo Clinic on May 28, 1954. Seven days previously she had been struck by a car and had sustained compound comminuted fractures of the right tibia and fibula and lacerations of the face, which had been repaired that night. Four days later, while in the hospital in her home community, she had begun bleeding from the right side of the nose. Bleeding had continued in spite of repeated use of anterior and posterior nasal packs and 18 transfusions of blood.

On arrival at the clinic she was pale and weak, was vomiting blood, and was bleeding into the pharynx and through the nose. Complete studies of the blood by a consultant in hematology gave negative results except for anemia. The site of hemorrhage seemed to be high in the anterior part of the nose. The bleeding was controlled for 36 hours by reinsertion of anterior packs. Then bleeding recurred, and on May 30, 1954, the right anterior ethmoidal artery was ligated through an orbital approach. When this failed to stop the bleeding, the right external carotid artery was ligated in the neck. This controlled bleeding for only five hours, when it recurred. After 18 hours of attempted control, again with packs, the left external carotid artery was ligated in the neck, this time with control of the bleeding that had persisted. During this time the patient received an additional 3000 cc. of blood by transfusion. During the next five days there was occasionally very minor bleeding that

§ References 6, 12 to 16.
‖ References 17 and 18.
¶ References 5 and 19.
# References 5 and 20.

was easily controlled with small packs. X-ray examination of the head and sinuses did not reveal any fractures. The blood that filled the tympani disappeared. A peripheral facial paralysis that developed on the left was receding before the patient was dismissed. When she was seen again six weeks later she had had no further bleeding, she had experienced 90% recovery from the facial weakness, and she did not present any evidence of arterial insufficiency to the face.

COMMENT

It is well known that the nasal cavities enjoy a very rich arterial blood supply, but the extent of the collateral arterial supply to this region is not so well appreciated. Abrahams [16] said that the arterial supply to the nose is fully re-formed a few days after excision of one external carotid artery, and ligation of the end of each branch. No sequelae to multiple or single ligations at the sites we have mentioned have been reported, in spite of the fact that a large number of such ligations have been performed. Both of the ethmoidal and sphenopalatine arteries have been ligated in bilateral external frontosphenoethmoidal operations without sequelae of arterial insufficiency.

The collateral blood supply to the nose comes from within and without the nasal cavities, and from the same side and the opposite side. Among the smaller arterial vessels in the nasal mucoperiosteum there is a broad anastomosis that involves branches of all the major arteries supplying the nose. This is especially pronounced in Little's area, where there are extensive anastomoses between branches of the nasopalatine branch of the sphenopalatine artery, the septal branch of the superior labial artery, and nasal branches of the descending palatine artery. The same sort of free anastomoses occur wherever areas of different supply adjoin in the nasal lining. On the same side there are extensive anastomoses between branches of the internal maxillary, the external maxillary, the ascending pharyngeal, and the lingual arteries. In addition, the superior thyroid artery has a large anastomosis with the inferior thyroid artery coming from the thyrocervical trunk of the subclavian artery, and the occipital branch of the external carotid artery has multiple anastomoses with branches of the thyrocervical trunk in the neck. From across the midline there are additional extensive anastomoses with many of the branches of the external carotid system in the neck, face, and pharynx. Also, the inferior and superior thyroid arteries of each side anastomose freely with the corresponding arteries of the opposite side, and the circle of Willis is an important route of collateral supply to the ethmoidal vessels from the opposite side.*

Thus it may be seen that there are innumerable pathways for effective collateral arterial supply to the nose in various cases of arterial failure. Some have suggested that the cause of failure of arterial ligation to control epistaxis in some cases lies in the choice of vessel ligated.† Another cause could be the rapid reestablishment of arterial supply by one or more collateral routes. Because of this fact, some have advocated transantral ligation of the internal maxillary artery.‡ It may be that the only reason arterial ligation (single) is usually effective in these cases lies in the fact that time is required for collateral circulation to develop fully; failures, then, could often be due to rapid development of collateral circulation. This might be especially true when the bleeding site is near a broad dividing line between adjoining areas of different arterial supply.

Our first case most likely represents bleeding from two different sites on two different occasions, each of such severity that ligations were necessary for control. The significant factor here is that such ligations may be required and that they may be done without sequelae.

Our second case indicates that both external carotid arteries may be ligated practically simultaneously without sequelae. In addition, it illustrates that an effective collateral supply of arterial blood can be developed rapidly after obliteration of nearly the total arterial supply to one side of the nose.

* References 5 and 22.

† References 7, 15, and 23.

‡ References 17 and 18.

In this case the collateral supply presumably came mostly from the opposite side and by way of the branches of the external carotid system, as indicated by the result following ligation of that vessel. That other routes were opened up is evident from the absence of sequelae.

SUMMARY

In two cases of severe epistaxis that required ligation of both external carotid arteries for control, no sequelae of arterial insufficiency developed. The collateral arterial supply to the nose is reviewed, and it is pointed out that the extensive nature of the collateral supply accounts for the absence of sequelae after ligation and for the occasional failure of arterial ligation to control epistaxis.

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Bronchial Biopsy Versus Papanicolaou Smears in Bronchogenic Carcinoma

ELMER J. SHABART, M.D., Livermore, Calif.

An evaluation of bronchial biopsy and the study of bronchial secretion for tumor cells as an aid in the diagnosis of bronchogenic carcinoma have been made in the Thoracic Surgery Department of the Hines Veterans Administration Hospital. In comparing the relative results of each of these two means of establishing a positive diagnosis, we have made three distinct study groups of 108 proved cases of bronchogenic carcinoma. The cases do not necessarily represent distinct and separate cases of bronchogenic carcinoma, as many overlap into one or the other of these three study groups. Mention should be made that all bronchoscopies and techniques were done or directly supervised by men fully experienced in the normal and abnormal findings within the tracheobronchial tree. In two and one-half years, a total of 859 consecutive bronchoscopies were performed for diagnostic reasons (Table 1). There were 108 cases of bronchogenic carcinoma. Woolner reported 588 diagnostic bronchoscopies, in which series there were 147 carcinomas.

TABLE 1.—*Diagnostic Bronchoscopies*

Patients in Whom Bronchoscopies Were Performed, No.	Patients with Proved Bronchogenic Carcinoma	
	No.	%
859 (Shabart)	108	13
588 (Woolner)	147	25

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Chief of Surgical Services and Thoracic Surgeon, Veterans Administration Hospital.

In our series of bronchoscopies there were 108 cases of bronchogenic carcinoma proved by either biopsy, exploration, or autopsy. All bronchoscopies were done for diagnostic purposes, indicated primarily on the basis of clinical symptoms, namely, cough, fever, chest pain, hemoptysis, wheeze, or loss of weight, along with concomitant x-ray findings of pulmonary pathology. In the 859 bronchoscopies, not only were biopsy specimens taken where indicated but also secretions were collected for bacteriological and fungus studies.

In Study 1 an analysis was made of the positive bronchial biopsy specimens obtained in the proved cases of bronchogenic carcinoma (Table 2).

TABLE 2.—*Bronchial Biopsies*

Author	Proved Cases Bronchogenic Carcinoma, No.	Bronchoscopies Performed, No.	Biopsies Performed, No.	Positive Biopsies	
				No.	%
Shabart	108	106	81	45	42
Ochsner	195	...	..	74	37.9
Hollinger	175	...	..	136	78
Herbut and Clerf	57	...	..	24	42
Herbut	307	...	..	104	33.8
Wandall	82	...	..	45	55
Gibbon	...	...	..	..	44

There were 108 carcinomas which had been proved by direct biopsy, bronchial biopsy, or autopsy. There were 81 bronchial biopsy specimens taken, of which 45, or 42%, were positive. The policy was to take a biopsy specimen of any irregularity noted within the bronchial tree. Essentially, the types of abnormalities noted were the presence within the bronchial lumen of a reddish, fungating, papillomatous, easy bleeding mass or a polypoid, mulberry-like tumor. The third type was an ulceration with rounded edges and a necrotic base. The fourth type was characterized by an indurated wall with pale mucosa, which had a tendency to be mottled. This type had no visible tumor, as the tumor extension is submucosal in location. It is in this latter group that the greatest per cent of error can occur, and for this reason a biopsy specimen was taken of any such suspicious mucosa without a projecting mass. Bjork has pointed out that centrally located lesions produce positive bronchial biopsies in 86% of the cases, intermediately placed lesions in 30%, and peripheral lesions present no positive biopsies. Since these 108 cases were of all three varieties in regard to location, we have concluded that our rate of 42% positive biopsies revealed satisfactory evaluation of the bronchial trees in most instances. We feel our 42% falls well within the pattern of other workers, as shown in Table 2.

In our second study, an evaluation was done on the results of bronchial secretion study for tumor cells by the method of Papanicolaou (Table 3).

In 268 cases in which 74 cases of bronchogenic carcinoma existed, we submitted 303 bronchial secretions for study. A positive report was given on 43 specimens submitted, in which 6 proved to be false positives, as proved by exploration and direct biopsy or autopsy. Two specimens were reported as having atypical cells in which the pathologist declined to make a definite decision as to whether the cells were neoplastic, and are not included in the 43 reported as definitely positive.

TABLE 4.—*Positive Papanicolaou Smears*

Author	Cases with Proved Carcinoma, No.	Positive Papanicolaou, %
Wandall	100	84
Herbut and Clerf	57	82
McKay	54	74
Farber	71	80
Woolner and McDonald	100	68
Barrett	..	68
Gowar	..	64
Shabart	74	53

To summarize this study, there were 74 cases of proved bronchogenic carcinoma in which the pathologist was correct in 87%-91% of his reported positive specimens, while actually we were able to prove carcinoma by Papanicolaou study in 50%-53% of the 74 proved cases, either of the figures, 87%-91% or 50%-53%, applying, depending on whether we accept or decline the report of atypical abnormal cells as a positive report.

In comparison with other figures reported in the literature, our percentage of positive secretions appears slightly lower (Table 4). It is important to realize that in order to obtain a positive smear the lesion must be in communication with a patent lumen of the bronchial tree. This is not so apt to be present in the case of a carcinoma presenting itself with an indurated wall and submucosal location. This may have been a factor in our lower percentage of positives.

I should like to call attention that the Papanicolaou study of bronchial secretions involves many variables. In the first place,

TABLE 3.—*Papanicolaou Smears*

Cases of Bronchogenic Carcinoma	Specimens	Proved Carcinoma	Positive Smears	Atypical Cells	False Positive	Carcinoma Proved by Positive Smear
268	303	74	37	2	6	50%-53%

the diagnosis of positive or negative secretions hinges on the experience and technical analysis of the pathologist. It goes without question that he must be adequately trained to differentiate normal and abnormal isolated tumor cells. He must be painstaking in his examination of the smears so that no portion of the smear goes unexamined, less he miss neoplastic cells in a small portion of the prepared smear. The bronchoscopist himself plays an important role. He should be thorough in his aspiration of the bronchial tree; and if no secretions are present and he suspects carcinoma, he should carefully irrigate that specific portion of the bronchial tree under suspicion and follow with thorough aspiration. Following aspiration, he himself should prepare all slides with care so that the secretions will be thin enough to allow the pathologist the maximum chance of studying individual cells. We sincerely hope that, as bronchoscopists and pathologists increase their experience, we will be able to increase our percentage of positive diagnoses. However, there will always be that small percentage who will be diagnosed only by exploration and direct biopsy.

The technique for preparing our slides was identical to that originally recommended by Papanicolaou in 1943. Mention might be made of an alternate method in which the secretions collected are centrifuged and the sediment prepared in paraffin block for microtome section and stained slide analysis. This latter method was not used in any of these cases.

Study 3 reveals the relative merits of Papanicolaou study versus bronchoscopic biopsy (Table 5).

In this series we had 64 cases of bronchogenic carcinoma proved by biopsy, exploration, or autopsy. Sixteen, or 25%, of the cases gave both a positive biopsy and Papanicolaou; 12 cases, or 19%, had a positive Papanicolaou but a negative biopsy; 21 cases, or 33%, had a negative Papanicolaou but a positive biopsy; 15 cases, or 24%, had both negative Papanicolaou and biopsy. Of these 64 proved cases, there was a total of 44% of the cases with a positive Papanicolaou, while 58% had positive biopsies. We were able then to obtain a positive diagnosis in 76% of the 64 cases by either Papanicolaou study, bronchial biopsy, or both. In 24% of the cases we were unable to obtain any evidence that we were dealing with a malignant growth. In this latter group the diagnosis was finally made on exploration or at time of autopsy. It is in this group of patients that, as our experience becomes increased, we hope to obtain more positive reports. Our ability to prove carcinoma in 76% of the cases compares favorably with that of Jackson, who reported 74% positive diagnosis in 100 cases reviewed, as well as that of Liebow, who reported 76% positive in his series.

TABLE 5.—*Papanicolaou Stain vs. Bronchoscopic Biopsy*

Proved Cases of Carcinoma, No.	Positive Biopsy and Positive Papanicolaou		Positive Papanicolaou and Negative Biopsy		Negative Papanicolaou and Positive Biopsy		Negative Papanicolaou and Negative Biopsy	
	No.	%	No.	%	No.	%	No.	%
64	16	25	12	19	21	33	15	24

Positive Papanicolaou	44%
Positive Biopsy	58%
Positive by Papanicolaou or Biopsy	76%

COMMENT

If we compare the three study groups, we find bronchogenic carcinoma was proved in 42% of the cases in Study 1 by bronchoscopic biopsy. In Study 2, 50%-53% of the cases were proved by the Papanicolaou study, the pathologist being correct in 87%-91% of his positive reports; and in Study 3, where combined studies were done, 58% were proved by bronchoscopic biopsy and 44% by the Papanicolaou study. We have used secretions

aspirated by bronchoscopy rather than sputa studies because we feel that early in bronchogenic carcinoma the cough which may be present is nonproductive and, while awaiting productivity, valuable time can be lost. Likewise, we feel sputa studies do not help localize the carcinoma in the pulmonary bed, as the malignant cells may be from the nasopharynx, trachea, or esophagus.

It is our belief that a high percentage of diagnoses of bronchogenic carcinoma cannot be made by bronchial biopsy or bronchial secretion study alone, but that by careful combination of the two methods well over 75% of the cases can be diagnosed. Secondly, by constant use of the two techniques and further diligence of the bronchoscopist and the pathologist, the 24% group of the negative Papanicolaou and bronchial biopsy could be materially lowered.

Considerable significance can be gathered from such figures. The mere failure to obtain a positive biopsy or positive secretion study for tumor cells does not rule out carcinoma. Carcinoma is now the number one cause of cancer death in men, and this significance must be respected. The predominance of the clinical symptoms of pulmonary infection lulls the unwary into procrastination, plus the fact there is a tendency to rely too much on the wonder drugs, namely, the antimicrobial group. Under antimicrobial therapy there is a tendency for the patient to feel better as the infection is brought under control for a limited time; but usually tell-tale evidence of existing pathology, with failure to complete clearing on x-ray examination, is still present. The temporary feeling of well-being should never overshadow x-ray evidence of still existing disease. It is important to point out that other workers have shown more time elapses from the time the patient sees his physician and has final definitive treatment than from the time symptoms first develop and he eventually sees his physician. The fault therein lies in the physician who is unwilling to accept the presence of carcinoma as a possibility and is willing to procrastinate with antimicrobial drugs. If the clinical picture presents symptoms suggestive of a lung cancer, and one has either positive diagnosis by bronchoscopic biopsy or by the Papanicolaou, exploration without delay is indicated, unless contraindicated by poor general physical condition, extension of the carcinoma beyond the hemithorax, or bloody effusion.

Some workers have advocated exploration in spite of the presence of bloody effusion. We have rarely found an operable situation in such cases, but we wonder if we are not justified in exploring such cases with the idea that we may, on occasion, salvage a case. Similarly, many have considered hemidiaphragmatic paralysis or vocal cord paralysis by encroachment of the tumor mass on the phrenic nerve or recurrent laryngeal nerve as contraindications for exploration. It is our opinion, in view of some successful radical resections reported in the literature, that one is justified in exploring such cases. The same holds true for involvement of sympathetic nerves as manifested clinically by Horner's syndrome.

If the Papanicolaou smear is positive, exploration should be done and every attempt be made to obtain a direct biopsy specimen confirming malignancy, as no extensive resection should be done on the basis of a positive Papanicolaou alone. Finally, if the bronchial biopsy is negative and/or the tracheobronchial secretions are negative but the history and clinical course suggest malignancy, and x-ray studies reveal evidence of unexplained lung pathology, exploration is indicated to rule out such malignancy. In such a case the time factor is important. One must always bear in mind the many manifestations of pulmonary carcinoma, particularly the one of pulmonary inflammation.

Prolonged procrastination, with the hopes that a pulmonary lesion will eventually clear, oftentimes converts a definitely operable carcinoma into an inoperable status. Bronchoscopy with bronchial biopsy, Papanicolaou study of tracheobronchial cells, or paraffin blocks made from the tracheobronchial secretions should be considered as weapons for

establishing the presence of a malignant growth in a lung; but negative studies must not be taken as factual proof that a malignant growth does not exist. Early thoracotomy with exploration and an attempt to establish with certainty the diagnosis by direct biopsy should be the rule. It is only with such an aggressive but intelligent attack that the percentages of five-year survival rates for bronchogenic carcinoma can be increased. In suspected cases with negative biopsies and bronchial secretions, we feel one is more justified to explore and obtain direct biopsy specimens than to wait for bronchial biopsies or secretions to turn positive with passage of time.

SUMMARY

Forty-two per cent positive bronchial biopsies were obtained in 108 proved cases of bronchogenic carcinoma.

Fifty to fifty-three per cent positive Papanicolaou reports were obtained in 74 proved cases.

In 64 proved cases, 44% positive Papanicolaous and 58% positive bronchial biopsies were obtained, totalling 76% positive reports by either Papanicolaou or biopsy.

Twenty-four per cent produced no positive secretion study or positive biopsy. This does not mean carcinoma is not present.

The dangers of antimicrobial therapy are stressed.

Exploration early for direct biopsy in all suspected cases is advocated. There is no place for doubt or procrastination if the five-year survival percentages are to be increased.

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Traumatic Nasal Deformity in the Newborn

JOHN A. KIRCHNER, M.D., New Haven, Conn.

Lateral displacement of the nose in the newborn is usually due to one of two types of trauma: (1) recent, occurring during birth; (2) prenatal, occurring as the result of forces applied to the nose during the late months of intrauterine life.

The first, or birth-injury type, results from excessive pressure on the cartilaginous portion of the nose during birth and usually consists of a dislocation of the septal cartilage from the vomer, with resultant deviation of the cartilaginous portion of the nose from the midline. The nasal bones are uninjured, so that treatment is a simple matter of replacing the tip of the nose in the midline between the thumb and forefinger.[1] Swelling or other signs of recent trauma may be present. More severe birth injuries have been mentioned occasionally in the literature, such as spontaneous fracture during labor [2] or fracture as the result of improperly applied forceps blades.[3]

The second type of deformity consists of a lateral displacement of the bony, as well as the cartilaginous, pyramid and septum. In contrast to the birth-injury type, this displaced nose cannot be repositioned in the midline even by means of instruments. The deformity is frequently quite marked, and often extremely distressing to the parents. Yet, practically nothing exists in the otolaryngologic literature to guide the practitioner in its management. Several otherwise excellent articles discuss the effects of nasal trauma in early childhood but make no mention of this particular condition existing at birth.*

Most pediatric textbooks make no mention of this condition, while certain others offer opinions which are somewhat misleading. Moncrieff and Evans' textbook offers an excellent discussion on nasal injuries in children but, in describing septal deviation at birth, states: "It is apt to increase with the growth of the nose." [8] The Mitchell-Nelson textbook, in discussing injuries present at birth, states: "If callus has already formed, it may be necessary to use splints, tampons, or packing." [9] The only detailed description of this condition I could find in the otolaryngologic literature was a discussion by Cottle, who, after discussing the birth-injury type of deformity, states:

> A deformity seen less often at birth, but still not so infrequently, is the nose that has apparently been compressed or otherwise injured sometime, perhaps months before labor starts. The infant is born with a well marked and completely healed deformity, with or without marked distortion of the nasal tip and nostrils. For these, expectant waiting is recommended unless there is complete inability to breathe and eat. One sees remarkable improvement in the appearance and development of these noses without any surgical intervention.[1]

In the past two years, I have had the opportunity of examining three such deformities, all in patients of Dr. Morris Wessel, of the Department of Pediatrics. From our conversations with other members of the pediatrics and obstetrics staffs, we both feel that other similar deformities occurred during this period of time, but were attributed to transient edema, hematoma, or flattening of the nose during labor.

Two of the following three cases occurred in siblings.

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From the Otolaryngology Section, Yale University School of Medicine.

* References 4 to 7.

REPORT OF CASES

CASE 1.—Janet H., born July 13, 1952. Baby's nose appeared to be pushed markedly to the left.

Physical Examination.—Bony pyramid deviated to the left of the midline. No crepitation or mobility. Cartilaginous pyramid deviated to the left of the midline. Septum occupied a position to the left of the midline and produced an obstruction of the left nasal chamber. There was no evidence of dislocation of the septum from the vomer. Lobule: The tip lay to the left of the midline, and the nostrils exhibited a typical lateral displacement deformity. There was no difficulty in nursing; no apparent obstruction to nasal respiration. No other evidence of recent trauma.

"Past" History.—Born from L. O. A. position. Normal spontaneous birth after six-hour labor.

Family History.—The mother, a primipara, had fallen in the bathtub about a month prior to delivery, bruising the left gluteal region. The mother had been treated on several occasions during her pregnancy for urinary retention as a result of a retroverted uterus.

No abnormalities of the bony pelvis or birth canal were discovered by the obstetrical consultant. According to the grandmother, both the mother and her two brothers had "squashed noses" at birth. All three now have midline noses.

Fig. 1 (Janet H.).—Deviation of nose noted at birth.

Fig. 2 (Janet H.).—Distortion of tip as result of lateral deviation of nose and septum. Attempted realignment with instrument unsuccessful.

Treatment.—Manipulation having failed to realign the nose, 5%-cocaine-moistened cotton pledgets were inserted under each nasal bone. A thin, strong, metal elevator was inserted under the nasal bone, but the bony pyramid could not be moved.

X-rays were then made and reported as follows: "Examination of the nasal bones demonstrates a general tilting of the nasal bones and septum towards the left. In the lateral view, there appears to be a greater separation between the nasal bones and frontal bone than usual, indicating the probability of a fracture. . . ." X-ray diagnosis: Fracture, nasal bones.

A second attempt was made to realign the nose with an elevator two days after the first attempt. The bony pyramid could not be moved, even with considerable force. The nasal deformity appeared as shown in Figures 1 and 2, when the patient was discharged from the hospital.

Follow-Up.—At 2 months of age, the patient was reexamined. At this time, the mother stated that when the child reached the age of about 2 weeks, the nose appeared to be normal. On this visit, the nose occupied the midline, the bony pyramid was symmetrical, the septum was midline, and the nasal chambers appeared equal in size (Fig. 3).

At 2 years of age, the nose was reexamined and appeared normal in all respects (Fig. 4).

CASE 2.—R. H., brother of Janet H., born May 7, 1954. Normal spontaneous delivery after five hours' labor, delivered from R. O. A. position. No abnormalities noted except that the nose appeared displaced considerably to the left of the midline.

Family History.—No history of injury with this pregnancy. Mother had a false labor one month before delivery.

Physical Examination.—The bony pyramid, cartilaginous pyramid, septum, and lobule were displaced to the left. There was a partial obstruction of the left nasal chamber by the cartilaginous septum, but there was no impairment of nasal respiration.

Treatment.—Digital manipulation having failed to correct the deformity, a 5%-cocaine-moistened cotton tampon was placed in each side of the nose, and an attempt made to realign the nose with a metal elevator. This was unsuccessful, and the patient was discharged with a moderate lateral displacement of the nose.

Follow-Up.—At 2 months of age, the nose occupied the midline, the nasal septum appeared straight, and the airway appeared equal on both sides.

CASE 3.—M. DeF., born Sept. 8, 1953, of a normal, spontaneous labor. No abnormalities noted except that the nose was shifted markedly to the left of the midline.

History noncontributory.

Reduction by means of an elevator was unsuccessful.

At 3 months of age, the nose appeared straight and in the midline. There was only a slight difference in the shape of the two nostrils. In March, 1955, the nose appeared completely straight and in the midline. The nostrils were symmetrical.

Fig. 3 (Janet H.).—Two months of age. Nose and septum straight. No interim treatment.

Fig. 4 (Janet H.).—Two years of age. Nose straight. Septum in midline.

Note: Colored slides of Cases 2 and 3 are on file in our teaching collection. Having been photographed with a ring-type electronic flash, the pictures lack shadow, and are unsuitable for reproduction in black and white.

COMMENT

That prenatal trauma and healing has been the etiological agent in this type of abnormality, as suggested by Cottle, is indicated by several observations:

1. The nasal displacement has in all cases been the only abnormality of the nose or of any of the bones of the face or skull.

2. Palpation of the bony nasal pyramid reveals that its apex leans away from the midline and that one side is long and flat; the other, short and upright, as is characteristic of lateral traumatic injuries in later life. This physical finding is substantiated by x-ray.

3. The nose and displaced septum have rapidly resumed the midline position in all cases within a period of three months without treatment.

4. Although Janet and her brother both had nasal deviations to the left, Janet was born from an L. O. A. position, her brother from R. O. A., indicating that the injuries had occurred before the onset of labor.

SUMMARY AND CONCLUSIONS

In the newly born infant, fixed lateral deviation of the nasal bony arch is due to prenatal trauma, possibly a sudden blow against the bony pelvis or, more likely, a prolonged pressure of the nose against a bony prominence. The displacement having occurred, the bone heals in this position by the time of

delivery, so that the nose cannot be repositioned in the midline even after cocainization and instrumentation. The nose assumes a midline position before 3 months of age without treatment.

Otolaryngology Section, Yale School of Medicine.

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Clinical Trial of Tetrahydrozoline Hydrochloride

A Valuable New Nasal Decongestant

ISIDORE NEISTADT, M.D., Valley Stream, N. Y.

This report presents details of a clinical trial of tetrahydrozoline hydrochloride (Tyzine), a new sympathomimetic agent useful in 0.1% aqueous solution as a topical vasoconstrictor and nasal decongestant.

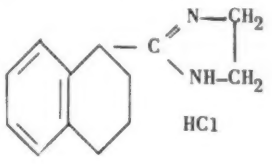
The effectiveness of tetrahydrozoline, as measured by its promptness of action, degree of relief provided, and the percentage of patients benefited, is superior.

The decongestive action of tetrahydrozoline is notably prolonged, so that instillations every four to eight hours, or at longer intervals in some cases, are sufficient to maintain continuous relief; instillation at bedtime provides relief that carries through the night.

Tetrahydrozoline is also free of both local and systemic side-effects.

BACKGROUND

Pharmacologic tests with tetrahydrozoline, which is designated chemically as 2-(1,2,3,4-tetrahydro-1-naphthyl) imidazoline hydrochloride, suggested that this recently synthesized compound should prove highly effective and free of the disadvantages of its predecessors. The structural formula of tetrahydrozoline is as follows:



Empirical formula	$C_{13}H_{15}N_2Cl$
Molecular weight	234. 73

Tetrahydrozoline consists structurally of an aromatic nucleus and a side radical containing an NH group. Tetrahydrozoline differs from other similar compounds by having only one carbon atom rather than two between the aromatic nucleus (tetrahydronaphthyl) and the nitrogen in the side radical.

Pharmacologic tests showed that 0.1% aqueous solution of tetrahydrozoline did not inhibit the motion of cilia in rat tracheal rings, and thereby suggested that its use clinically should not inhibit the desirable ciliary movement of nasal mucus. Repeated applications to the eyes of rabbits produced no irritation. The L. $D._{50}$ of tetrahydrozoline in mice showed this compound to be considerably less toxic than two other agents most frequently used as nasal decongestants. Absence of a central stimulatory action in mice given tetrahydrozoline intravenously suggests that the clinical use of this agent should not produce nervousness or insomnia even if transnasal absorption occurred. No transnasal absorption was indicated by blood-

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Tetrahydrozoline hydrochloride in 0.1% aqueous solution (Tyzine) for intranasal use was supplied for this study by Dr. F. E. Bishop, of Chas. Pfizer & Company, Inc., Brooklyn, N. Y.

pressure determinations, however, in dogs given 1 cc. of 1% solution intranasally.

DETAILS OF CLINICAL TRIAL

A total of 204 patients were included in this study. These consisted of 96 male and 108 female patients ranging in age from 19 months to 77 years, including 12 children, none of whom was older than 6 years. Treatment was given for relief of nasal congestion incident to allergic rhinitis in 12 patients, nasopharyngitis (acute rhinitis or coryza) in 102, sinusitis in 34, and both nasopharyngitis and sinusitis in 56.

Duration of Relief with Tetrahydrozoline in 204 Patients

Duration, Hr.	Patients, No.
4	7
4-8	49
8	130
8-12	8
12	5
18	2
8-24	3

The preparation used in treatment was a 0.1% aqueous solution of tetrahydrozoline, which is odorless and tasteless and of pH 5.5 to 6.5. The dosage in all cases was 5 drops in each nostril four times daily. The duration of treatment ranged from 4 to 16 days (an average of 10 days).

RESULTS

An excellent therapeutic response was obtained with tetrahydrozoline in all 204 patients except 1, whose response was only fair. Relief appeared immediately after instillation of the solution and lasted 4 to 24 hours. The duration of relief obtained with tetrahydrozoline by the patients of this series is shown in the accompanying Table.

It will be seen that after each instillation 192 of the 204 patients (or 90%) had relief for periods up to or exceeding eight hours. This means that the effect of a bedtime instillation generally lasted through the night, without return of congestion causing wakefulness to instill more drops before morning. Actually no patient awakened because of need of further drops.

One patient had suffered from local irritation on using all other nose drops but found tetrahydrozoline nonirritating; 12 patients had been troubled by awakening at night because of recongestion when using other preparations but found the effect of tetrahydrozoline to last until morning, and 4 patients volunteered that tetrahydrozoline was the only nasal decongestant that they had found effective at all.

The only instance of what might be called a side-effect was a complaint of slight stinging in one case, but this patient was nonetheless relieved and continued the medication. None of the significant side-effects, local or systemic, previously mentioned as common with other effective preparations were produced by tetrahydrozoline in this series.*

SUMMARY

This report describes a trial of a new sympathomimetic agent, tetrahydrozoline hydrochloride (Tyzine), as a nasal decongestant solution (0.1%) in 204 patients—12 with allergic rhinitis and 192 with nasopharyngitis or sinusitis or both. Results were excellent in all but one patient, whose response was only partial. Besides this high effectiveness, tetrahydrozoline displayed the notable advantages of prolonged action and absence of untoward effects, local or systemic.

114 Du Bois Ave.

* More than 1 or 2 drops of tetrahydrozoline given to children under 2 years of age may cause undesirable side-effects. It is undesirable to use plastic spray packs for children.

Laryngeal Carcinoma in Connecticut

Observations with Particular Reference to Its Surgical Treatment

TIMOTHY L. CURRAN, M.D., Hartford, Conn.

A careful perusal of the literature fails to reveal a comprehensive review of the history of laryngeal carcinoma in Connecticut. We are all aware of the fact that carcinoma in general has shown a progressive increase in recent years. This has been attributed to several factors, but the most positive reason for the increase is the prolongation of life by modern science. Since 1900, the average life span has increased 20 years, so that now the life expectancy of a person is 67 years of age. Although much has been written about the absolute and relative increase in carcinoma of the lung as compared with that in cancer involving the other organs, no such increase in incidence apparently has been shown to occur in laryngeal carcinoma. Laryngeal carcinomas, however, have shown a steady increase, according to statistics, in the past 25 years. Since well over 50% of carcinoma of the larynx occurs after the age of 60, it is evident that we are to face this problem more frequently in the future. It therefore seems pertinent to ask the following questions: What has been done in the treatment of carcinoma of the larynx in Connecticut? What can be done to improve this treatment? What have the laryngologists in Connecticut contributed to this treatment, and can we expect them to improve their results in the future?

Submitted for publication Feb. 2, 1955.

Presented as a candidate's thesis in partial fulfillment of the requirements for membership in the American Laryngological, Rhinological and Otological Society, Inc.

HISTORICAL REVIEW

In order to evaluate completely the trend in the treatment of carcinoma of the larynx in Connecticut a thorough understanding of this disease as treated by the earliest laryngologists is indicated. Despite the fact that many controversial discussions concerning the treatment of laryngeal carcinoma can be found in the medical journals of the late 19th and the early 20th century, no consideration of this disease is found in our local medical journals, nor do we note any contributions by our Connecticut laryngologists in the national journals. The earliest report of treatment for laryngeal disease in the *Connecticut State Journal* was in 1876 by Chamberlain,[1] but his report at that time concerned the treatment of laryngeal congestion, and what he describes was apparently an acute laryngitis in which the treatment was primarily local applications of various medications, plus voice rest and the use of iced champagne by mouth. The latter was prescribed for its stimulating effect upon the laryngeal muscles, according to the author. Despite the fact that the laryngologists of Connecticut failed to include any reports of laryngeal carcinoma or its treatment in their literary contributions, the European and American laryngologists elsewhere made frequent and, at times, heatedly discussed additions to our knowledge of laryngeal carcinoma. The earliest surgery performed for laryngeal disease was, undoubtedly, tracheotomy, which was advocated by Asclepiades back in the first century B. C.[2] It was a recommended procedure only when the patient was in imminent danger of suffocation, and it is quite likely that some of these patients subjected to the operation

were victims of cancer of the larynx. However, over the years there was considerable controversy as to the advisability even of this procedure. According to Ryland,[3] it was not until the 17th century that the advocates of tracheotomy began to rise once again, and, since their results apparently showed some improvement compared with the effects of the procedure done centuries before, the operation gained acceptance.

Many persons contributed to the study and treatment of laryngeal disease and carcinoma of the larynx in particular. One of the earliest contributors to American laryngology was Dr. John Cheeseman, of New York, who reported the first case of papilloma of the larynx in 1817.[4] In 1851, Gurdon Buck,[5] who was known as the father of intralaryngeal surgery in America, performed the first laryngofissure in America for carcinoma of the larynx. He subsequently operated on the patient twice for recurrence before the patient died. Death occurred 18 months after the first operation and was due to the recurrence of the original lesion. To Billroth in 1873 goes the credit for performing the first laryngectomy.[6] In 1881, Gluck performed a two-stage operation for laryngectomy,[6] and this was calculated to prevent many of the postoperative complications which caused such a high mortality in laryngectomy. In 1883, Butlin[7] published his monograph on malignant diseases of the larynx. He noted that many surgeons believed that a tracheotomy gave the patient months to years of life and that this period of time was equal to what could be accomplished by radical surgery. One of the first series of cases of laryngectomies performed in America was reported by Bevan[8] in 1902. Two of the cases reported had pharyngeal stomas which failed to close, and in the third case he performed a two-stage laryngectomy. Bevan at that time stated that many throat specialists and general surgeons were opposed to radical surgery in carcinoma of the larynx. Bevan went on to state that (1) early cancer of the larynx can be removed by laryngectomy or thyrotomy, with a mortality of only 10%; (2) 50% of those recovering from the operation will live from one to eight years; (3) comparison of operative and nonoperative cases indicated that early operative intervention was not only warranted but dictated by the history of these cases. The statement of Dickerman that many cases of carcinoma of the larynx if left alone continued to live many years was criticized by Bevan.

In 1909 Chevalier Jackson reported 14 laryngectomies, with only 2 operative deaths.[9] Two of his patients survived for three years or more without recurrence of their laryngeal carcinomas.

In 1922, Woods[10] discussed the reasons for the unpopularity of the laryngectomy operation. He listed the objections as (1) magnitude of the procedure, (2) contamination of the wound from throat organisms, (3) feeding and nursing difficulties, and (4) the great tendency of the disease of recur. According to Woods, his first laryngectomy was performed in 1894 and the patient died in two weeks of pulmonary complications, which was the usual cause of postoperative death. He did not attempt another laryngectomy until 1909, and with the use of the feeding tube postoperatively the patient made an uneventful recovery.

In a discussion of Woods' paper, Crile agreed that intrinsic carcinoma offered a good chance of cure as compared with the poor outlook in extrinsic carcinoma of the larynx. It was Crile's opinion that no operation in surgery offered so certain and permanent a cure from cancer as total laryngectomy in intrinsic carcinoma of the larynx.

I have stated earlier that the history of surgical treatment of laryngeal carcinoma finds no mention of the contributions of Connecticut surgeons. However, in 1921 one of the leading general surgeons in Connecticut, Dr. William Verdi, performed the first reported laryngectomy in Connecticut. The patient, a 64-year-old man, lived for 22 years afterward. In all, Verdi treated 59 cases of laryngeal carcinoma from 1921 to 1948, and all but 2 of the cases were treated by surgery. Included in his series were 40 laryn-

gectomies, 4 laryngofissures, 2 hemilaryngectomies, and 11 tracheotomies. The latter were done for palliation only. Flynn,* in his presentation of this series before the New England Surgical Society in 1948, stressed the necessity for total laryngectomy in such a large percentage of the cases because of the far-advanced lesions which were present at the time of operation. One cannot fail to have the greatest admiration for the skill and courage of Verdi in the treatment of these patients. In reviewing the records, one finds that many of these patients presented themselves with sloughing wounds of the neck, massive cervical adenopathy and that in innumerable cases the patients were not seen until they were in marked respiratory distress. Many of these were seen and treated before the days of the antibiotics. Flynn mentions a specific case which had been refused operation in New York and Boston. The patient was operated upon by Verdi in separate stages, a neck dissection being first done on one side and then on the other side, followed later by a total laryngectomy. The patient recovered and was still living 20 years later. It is readily understandable why this great surgeon has been held in such high esteem by the laryngologists of his native state. Although Verdi pioneered the successful surgical approach to the treatment of laryngeal carcinoma in Connecticut, he was followed in subsequent years by several of our more prominent laryngologists, whose contributions to this work have helped to improve our statistical results. Men such as Canfield, Whalen, and MacCready have led the vanguard of laryngologists who are now performing this surgery in all of our larger Connecticut communities.

INCIDENCE

Recently Malkin and Kirchner [11] pointed out that there has been a marked increase in the number of patients with laryngeal carcinoma admitted to the New Haven Hospital. In the 20-year period from 1921 to 1940 there were 94 cases, while from 1941 to 1950 there were 136 cases. This rather marked increase in the past 15 years is noted in the over-all state statistics accumulated by the Cancer Research Division of the Department of Health in Connecticut. From 1935 to 1939 there were 93 cases, from 1940 to 1944 there were 152 cases, and from 1945 to 1949 the number had risen to 282. Much of the increase perhaps must be attributed to better reporting, but, as stated earlier, the incidence of carcinoma, because of our longer span of life, has shown a marked increase in recent years. The incidence by age and sex is shown in Table 1.

TABLE 1.—*Distribution of Cases of Cancer of the Larynx According to Age and Sex (Connecticut, 1935-1950)*

Male Patients

Age, Yr.	Total	1935-1939	1940-1944	1945-1950
Total	486	83	144	259
Under 20	..	..	..	..
20-24	..	..	..	..
25-29	1	..	1	..
30-34	1	..	..	1
35-39	9	1	4	4
40-44	8	3	3	2
45-49	33	4	9	20
50-54	64	8	23	33
55-59	80	19	21	40
60-64	99	13	33	53
65-69	76	20	20	36
70-74	64	8	14	42
75 and over	49	7	15	27
Unknown	2	..	1	1
Average age	62.3	62.3	61.4	62.8

Female Patients

Age, Yr.	Total	1935-1939	1940-1944	1945-1950
Total	41	10	8	23
Under 20	..	..	..	..
20-24	..	..	..	..
25-29	..	..	..	..
30-34	1	..	..	1
35-39	..	..	..	..
40-44	4	2	1	1
45-49	5	1	1	3
50-54	9	3	1	5
55-59	7	1	2	4
60-64	5	2	2	1
65-69	4	..	..	4
70-74	2	..	..	2
75 and over	4	1	1	2
Unknown	..	..	..	..
Average age	57.6	55.3	57.8	58.6

Approximately 50% of the reported cases of carcinoma of the larynx were diagnosed

* Flynn, C.: Personal communication to the author.

TABLE 2.—*Distribution of Cases of Cancer of the Larynx According to Size of the Hospital (Connecticut, 1935-1950)*

No. of Beds	No. of Hospitals	No. of Cases	Average No. of Cases per Hospital
Total	25	515	20.6
Under 150	7	37	5.3
150-199	5	30	6.0
200-299	5	64	12.8
300-399	4	111	27.8
400 and over	4	273	68.3

and treated at the four largest general hospitals in Connecticut (Table 2). These hospitals are located in New Haven and in Hartford. Although the other 22 hospitals reported only 50% of the total cases, there has been a definite trend during the past 10 years for an increasing amount of laryngeal surgery to be performed in the smaller hospitals. This, undoubtedly, has been due to the tendency for well-trained laryngologists in recent years to locate their practices in the smaller cities. A continued increase in the reporting of laryngeal carcinoma from these smaller hospitals can be expected in the future. One result of this should be a much closer observation of the patient by the surgeon and prompter follow-up treatment, if and when it is indicated.

RESULTS OF TREATMENT

In the treatment of cancer of the larynx in Connecticut, our results compare favorably with those reported from most large centers. Table 3 shows the status of patients five years after diagnosis. This includes treatment by surgery, radiation, and combined surgery and radiation.

From 1935 to 1945, a total of 284 cases were reported. The five-year results are shown in Tables 4, 5, and 6, with a break-

TABLE 3.—*Status of Patients with Cancer of the Larynx Five Years After Diagnosis (Connecticut, 1935-1945)*

	1935-1945		1935-1939		1940-1945	
	No. of Cases	% of Total	No. of Cases	% of Total	No. of Cases	% of Total
Total	284	100.0	93	100.0	191	100.0
Status of patients surviving 5 yr	82	28.9	24	25.8	58	30.4
Alive, free from cancer	73	25.7	23	24.7	50	26.2
Alive with cancer	9	3.2	1	1.1	8	4.2
Dead during first 5 yr	197	69.3	67	72.0	130	68.0
Dead, free from cancer	14	4.9	2	2.1	12	6.3
Dead with cancer	183	64.4	65	69.9	118	61.7
Lost to follow-up during first 5 yr	5	1.8	2	2.2	3	1.6
Lost, free from cancer	3	1.1	..	....	3	1.6
Lost with cancer	2	0.7	2	2.2	..	....

TABLE 4.—*Status of Patients with Cancer of the Larnyx Five Years After Diagnosis by Type of Treatment (Connecticut, 1935-1945)*

	Total		Limited Surgery for Cure		Limited Surgery for Cure and Radiation		Radical Surgery		Radical Surgery and Radiation	
	No. of Cases	% of Total	No. of Cases	% of Total	No. of Cases	% of Total	No. of Cases	% of Total	No. of Cases	% of Total
Total	284	100.0	20	100.0	3	100.0	48	100.0	12	100.0
Status of patients surviving 5 yr.	82	28.9	14	70.0	3	100.0	24	50.0	6	50.0
Alive, free from cancer	73	25.7	14	70.0	3	100.0	23	47.9	4	33.3
Alive with cancer	9	3.2	..	....	..	.....	1	2.1	2	16.7
Dead during first 5 yr	197	69.3	6	30.0	..	.....	22	45.8	5	41.7
Dead, free from cancer	14	4.9	2	10.0	..	.....	4	8.3	..	....
Dead with cancer	183	64.4	4	20.0	..	.....	18	37.5	5	41.7
Lost to follow-up during first 5 yr.	5	1.8	..	....	..	.....	2	4.2	1	8.3
Lost, free from cancer	3	1.1	..	....	..	.....	2	4.2	1	8.3
Lost with cancer	2	0.7	..	....	..	.....	2	4.2	1	8.3

TABLE 5.—*Status of Patients with Cancer of the Larynx Five Years After Diagnosis by Type of Treatment (Connecticut, 1935-1945)*

	Limited Surgery for Palliation		Limited Surgery for Palliation and Radiation		Surgery, Extent Unknown		Biopsy Removal		Radiation Alone	
	No. of Cases	% of Total	No. of Cases	% of Total	No. of Cases	% of Total	No. of Cases	% of Total	No. of Cases	% of Total
Total	10	100.0	34	100.0	1	100.0	6	100.0	116	100.0
Status of patients surviving 5 yr.	..	.....	2	5.9	..	.....	6	100.0	25	21.6
Alive, free from cancer	..	.....	2	5.9	..	.....	6	100.0	19	16.4
Alive with cancer	..	.....	..	....	..	.....	..	.....	6	5.2
Dead during first 5 yr.	10	100.0	32	94.1	1	100.0	..	.....	90	77.6
Dead, free from cancer	..	.....	1	2.9	..	.....	..	.....	7	6.0
Dead with cancer	10	100.0	31	91.2	1	100.0	..	.....	83	71.6
Lost to follow-up during first 5 yr.	..	.....	..	....	..	.....	..	.....	1	0.8
Lost, free from cancer	..	.....	..	....	..	.....	..	.....	..	....
Lost with cancer	..	.....	..	....	..	.....	..	.....	1	0.8

TABLE 6.—*Status of Patients with Cancer of the Larynx Five Years After Diagnosis by Type of Treatment (Connecticut, 1935-1945)*

	Unknown Treatment		No Treatment	
	No. of Cases	% of Total	No. of Cases	% of Total
Total	2	100.0	32	100.0
Surviving 5 yr.	2	100.0	..	....
Alive, free from cancer	2	100.0	..	....
Alive with cancer	..	.....	..	....
Dead during first 5 yr.	..	.....	31	96.9
Dead, free from cancer	..	.....	..	....
Dead with cancer	..	.....	31	96.9
Lost to follow-up during first 5 yr.	..	.....	1	3.1
Lost, free from cancer	..	.....	..	....
Lost with cancer	..	.....	1	3.1

down according to the treatment given. Limited surgery is confined to those patients on whom partial laryngectomy (laryngofissure) was performed. Radical surgery includes total laryngectomy as well as those cases on whom radical neck dissection was done. A separate classification was made for the six cases in whom biopsy removal of the tumor by direct laryngoscopy was accomplished. According to the statistics cited, six cases were treated successfully by biopsy removal, with no recurrence of the lesion. A word of caution is indicated in the interpretation of these results.

In examining the various records, I discovered one case in which a biopsy report was returned showing carcinoma of the larynx present. Subsequently, several more biopsy specimens were taken and found to be negative. This case was considered most unusual at the time and presented at a tumor clinic conference. However, approximately three years later, and one year after the last examination of the patient, the latter presented himself with an obstructing lesion of the larynx necessitating tracheotomy, laryngectomy, and neck dissection. He died 18 months later of the disease. Except in this case there was no evidence of delay in treatment of cancers of the larynx because of negative biopsies. Although direct laryngoscopy may remove a malignant growth where it is very early and on the free edge of the cord, such a patient requires extremely close attention, and even when negative biopsy reports have been obtained subsequently, the patient should not be lost to close follow-up. The tragic case [12] of Crown Prince Frederick of Germany, in 1887, is known to most laryngologists. The failure of Morell Mackenzie to insist on further biopsies of the larynx after the original negative report eliminated any chance of curing the Prince of his fatal disease. The latter's untimely death has been said by some to have changed the political and economic life of the world so that repercussions are felt even to the present day.

TYPE OF SURGERY PERFORMED

As stated before, the statistics of the Cancer Research Division of the Department of Health in Connecticut divide the surgery into limited or radical, with a separate category for biopsy removal. The determination

of the type of surgery performed is usually done by the attending physician, occasionally by the medical director of the tumor clinic, and in some instances by nonmedical personnel of the tumor clinic. A check is also made by the same persons as to whether the treatment was for cure or palliation. So many errors were discovered on examining the tumor clinic records that I believe that a change should be made in the method of recording the type of surgery performed. For example, in many instances a tracheotomy was done and the record was checked that radical surgery had been performed. Occasionally, when a tracheotomy was performed as a palliative procedure, due to laryngeal obstructive dyspnea, a check was made that the treatment was for cure, despite the fact that no other therapy had been given. The difficulty lies in the attempt to include all the necessary classifications under the IBM Card Index System. A separate code number for tracheotomy has been suggested so that it will not be included under limited or radical surgery, and thus a better statistical evaluation of these cases should be obtained. Actually much of the difficulty could be obviated if the attending physician would personally check his own tumor records and not leave this responsibility to a busy medical director or some member of the nonmedical personnel in the tumor clinic.

Many physicians listed the procedure of the removal of one vocal cord under such terminology as hemilaryngectomy, thyrotomy, partial laryngectomy, and, of course, laryngofissure. For purposes of simplicity, it is suggested that a procedure such as the removal of a single cord be listed as partial laryngectomy with further identification of the procedure where a variation has been done, for example, bilateral thyrotomy, suspension laryngoscopy, etc.

WHO PERFORMS THE LARYNGEAL SURGERY

In a recent survey, I discovered that at least 21 laryngologists are performing laryngeal surgery in Connecticut. There are approximately five general surgeons who include laryngeal surgery in their operative work. Up until recent years, many patients routinely had been referred by their physicians or laryngologists to larger centers in Boston, Philadelphia, New York, and Baltimore for surgery of the larynx. With the increase in laryngologists trained to perform this type of surgery, the number of referrals to out-of-state medical centers have been rare. With the exception of Verdi, who was the first to perform laryngeal surgery in Connecticut, the general surgeons have not produced any great volume of surgery on the larynx. Although some laryngologists have performed as few as two laryngofissures and no laryngectomies, the majority of laryngologists doing this type of surgery have performed 10 to 12 laryngectomies. Approximately a third of the laryngologists who are doing laryngeal surgery have also stated that they have done one or more radical neck dissections for cervical metastasis of laryngeal carcinoma. Although this is by no means a very large volume of radical neck surgery, it must be realized that general acceptance of this approach for treatment of laryngeal carcinoma is relatively recent among laryngologists. It has only been in the past few years that radical neck surgery has been performed by general surgeons in any great volume.

FOLLOW-UP REPORTS

In general, the follow-up reports on patients were good. The 26 hospitals which submit their reports to the Cancer Research Division send their records on each patient. Reports are submitted by the tumor clinics of these hospitals once a month, and a follow-up report on the individual patient is submitted once a year. These tumor clinics are manned by one or more personnel and are supported by the individual hospitals. A small subsidy is also received from the state. Cooperation of the physician is usually obtained, but where information is not available, the family or the patient is contacted directly by the hospital tumor clinic. Occasionally, the attending physician requests that the patient or the patient's family not be subjected to any inquiries. It is the feeling of some physicians that the patient's

privacy is being invaded, and this occasionally causes some difficulty in obtaining adequate information on the patient's response to treatment. Some physicians make little or no attempt at follow-ups on their patients. One otolaryngologist each year reports on his patient stating that "he must be all right, if he had any trouble he would be back again." Such a report does not give much useful information and may prevent the patient from obtaining curative treatment, if a recurrence of his lesion has taken place. An instance has occurred where the physician submitted a report year after year stating that the patient was alive and well and an investigation by the tumor clinic determined that the patient died some three years earlier. It would seem that for the little time and effort required, a more correct reporting can be given by attending physicians.

SPEECH TRAINING

The speech training of the laryngectomized patient can be accomplished in several ways in the state of Connecticut. The State Veterans Hospital is available to all patients who are veterans of the Armed Services. Chronically ill or aged patients, regardless of their veteran status, may also be accommodated at this institution. However, unless these patients are indigent, they must pay for their hospitalization. The Department of Rehabilitation of the State of Connecticut will also arrange for speech training for the laryngectomized patient. This can be done either on a private basis at the patient's home or at any recognized school of instruction. No charge is made by the Rehabilitation Department for this speech training. However, some proof must be given that the patient can be rehabilitated and able to carry on some useful occupation following his course of speech training. In addition, the Connecticut Cancer Society will take over the financial responsibility for the training of laryngectomized patients when the latter, though not destitute, will require some economic assistance.

COMMENT ON CASES REPORTED

I am including in this paper a summary of the cases which I have treated by surgery in the past six years. Although it is realized that this is not a large series, I feel that my results have been encouraging enough to continue with this work. In the first few years, I confined myself to the narrow-field type of laryngectomy, but this I have discarded in the past two years not only because of recurrence in my own patients but also because of the evidence that this type of laryngectomy increases the chance of local-

TABLE 7.—*Report of Author's Cases of Laryngeal Cancer*

Patient	Age, Yr.	Sex	Date of Operation	Lesion	Treatment	Result
1. J. R.	48	M	1947	Extrinsic cancer	Total laryngectomy	Died with disease 1948
2. W. M.	50	M	1947	Intrinsic cancer	Total laryngectomy	Died of coronary occlusion 1951; no recurrence
3. A. L.	55	M	1948	Intrinsic cancer	Total laryngectomy	Died with disease 1949
4. J. R.	49	M	1948	Intrinsic cancer	Total laryngectomy in 1948 Neck dissection in 1951	Died with disease 1952
5. J. O.	80	M	1948	Intrinsic cancer	Partial laryngectomy	Living and well
6. J. M.	33	M	1949	Intrinsic cancer	Total laryngectomy	Living and well
7. N. F.	63	M	1949	Intrinsic cancer	Total laryngectomy	Living and well
8. W. S.	62	M	1949	Intrinsic cancer	Total laryngectomy	Died with disease 1950
9. J. N.	38	M	1950	Extrinsic cancer	Total laryngectomy and neck dissection	Died with disease 1951
10. J. P.	65	M	1950	Intrinsic cancer	Partial laryngectomy	Living and well
11. A. K.	78	M	1950	Intrinsic cancer	Partial laryngectomy	Living and well
12. F. Y.	60	M	1951	Intrinsic cancer	Total laryngectomy	Living and well
13. J. A.	64	M	1952	Lymphoepithelioma (right cord)	Partial laryngectomy and x-ray	Died with disease 3 mo. later
14. W. C.	44	M	1952	Intrinsic cancer	Total laryngectomy	Living and well
15. W. H.	59	M	1953	Extrinsic cancer	Total laryngectomy and neck dissection	Living and well
16. W. K.	68	M	1953	Intrinsic cancer	Total laryngectomy	Living and well
17. J. F.	62	M	1953	Intrinsic cancer	Partial laryngectomy	Living and well

ized recurrence and cervical metastasis. As shown in Table 7, there were 12 laryngectomies performed and 6 of these patients are living and well. One patient died four years after the laryngectomy. At the time of death he was free of disease but died of a coronary occlusion. Neck dissections have been done on three patients, two of whom died of recurrence. The third patient had a combined laryngectomy and neck dissection. He is now free of the disease, but it is less than two years since his operation. Five partial laryngectomies have been performed and four patients are living and well. In one case a thyrotomy was done because of failure to obtain a positive biopsy specimen from the edematous tissue. The lesion appeared to involve only one cord and the latter was resected. X-ray therapy was given when the pathological report showed lymphoepithelioma to be present and extending to the cut edge of the specimen. The patient died of coronary occlusion three months later. No autopsy was done, but clinical disease was believed to be present.

SUMMARY AND CONCLUSIONS

I have presented a picture of laryngeal carcinoma in Connecticut, including a brief résumé of the history of laryngeal carcinoma and its surgical treatment from the earliest recorded reports. As stated in this presentation, very little was added to the surgical treatment of carcinoma of the larynx in Connecticut until 1921, when Verdi performed his first laryngectomy. I find it necessary to take issue with those who believe that the laryngologist should confine himself to keyhole surgery, using his endoscopy skill only to determine what type of operation the general surgeon should perform. A well-trained laryngologist should not confine himself to diagnosis alone. His training and experience, in many instances, do equip him to perform radical surgery, including neck dissection where indicated. Many chest surgeons prior to performing any lung surgery insist on doing their own bronchoscopies to determine the extent of the surgical procedure which they anticipate doing. The treatment of laryngeal carcinoma may require limited surgery or radical surgery or x-ray therapy. It should be up to the attending laryngologist to decide and initiate the treatment for his patients and then to continue to follow the patient adequately for any possible recurrence.

From my survey, I have discovered that many laryngologists feel that they should confine themselves only to diagnosis. One laryngologist stated that he had seen only 5 cases of laryngeal carcinoma in approximately 50,000 new patients. I believe that he laryngologist who is trained in laryngeal surgery and shows a keen interest in this disease will find an increasing amount of this type of surgery in his practice. To be successful in this work, one must be bold in his approach and not use halfway measures in his treatment. One should not do a partial laryngectomy if he is not prepared to go ahead and perform a total laryngectomy in case the lesion is too extensive for limited surgery. I believe also that he should not attempt a total laryngectomy unless he is also ready to perform a radical neck dissection in the event that metastatic nodes are found at the time of surgery. Since we are destined to see an increasing amount of laryngeal carcinoma in the future, the laryngologist must be prepared to treat this disease and he must do so without fear or timidity. The opposition to laryngectomy has diminished considerably in recent years. Laryngectomized patients are taking their places in the community and are performing their daily duties cheerfully and satisfactorily. The use of the antibiotics and improved techniques have increased our chances of success immeasurably. Here in Connecticut, we have a sufficient number of laryngologists trained in laryngeal surgery to assure patients of the best possible care as well as available close follow-up attention. It is no longer necessary for a patient with laryngeal carcinoma to travel hundreds of miles for limited or radical surgery, since all the facilities for his surgical treatment and postoperative speech therapy are within easy commuting distance.

In recording the statistics for tumor clinic records, it appears advisable to list the removal of a vocal cord as partial laryngectomy instead of the many other varied terms, such as laryngofissure, hemilaryngectomy, thyrotomy, suspension laryngoscopy, etc. A better description of the operation performed when it is recorded on the tumor records would help in evaluating the results of the procedure done.

Follow-up reports, although complete in most instances, show that many physicians give little or no thought to the correctness of their reports. The statistics are of no value unless the physician is conscientious in his follow-up examination and then renders an accurate report of the patient's condition. Better cooperation with the tumor clinic personnel in their attempts to gather information would be of extreme help to all of us.

There is every available facility in Connecticut for the speech training of the laryngectomized patient. Regardless of his economic status arrangements can be made for speech therapy through public or private organizations.

Mr. Earl Pollack, of the Connecticut State Department of Health, Division of Cancer Research, assisted in the preparation of statistical charts.

50 Farmington Ave.

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Effects of Tyzine and Other Vasoconstrictors on Ciliated Epithelium

DUNCAN E. HUTCHEON, M.D.
and
MARY ROSE CULLEN, B.S., Brooklyn

In the study of the effect of certain nasal vasoconstrictors, antihistamines, and antibacterial drugs on ciliated epithelium, Scudi and his colleagues [1] reported a parallelism between cellular irritation and loss of ciliary motility. An extrusion of globoid bodies from the surface of the ciliated epithelial cells was also observed after the cessation of ciliary motility. The purpose of the experiments reported here was to compare the effect of tetrahydrozoline (Tyzine), which has recently been reported to be an active vasoconstrictor,[2] with those of ephedrine, naphazoline, and phenylephrine on the ciliary movement of mammalian tracheal rings.

It was shown by Mittermaier,[3] Buhrmester,[4] and others that the pH of nasal secretions varies considerably in various pathological states from alkaline normally and in cases of allergic rhinitis to acid in patients with purulent and mucopurulent discharges. The changes in ciliary motility produced by tetrahydrozoline were, therefore, tested in acid, neutral, and alkaline media.

PROCEDURE

The method of Scudi, Kimura, and Reinhard was followed. Adult male albino rats were killed by a sharp blow to the dorsolumbar region. The tracheas were removed and cleared of adherent connective tissue. Cross sections of rings about 0.5 mm. in thickness were immersed in Locke-Ringer's solution maintained at 23 to 25 C. The pH of the solutions was determined with a Beckman, glass electrode, Model N, pH meter. To minimize the effect of animal variation, five tracheal rings were chosen at random from different animals. These rings were placed in Locke-Ringer's solution in Syracuse watch glasses and examined microscopically for ciliary activity. At magnification × 320 the cilia could be seen beating actively. This was found to continue for a period of several hours. Tetrahydrozoline, naphazoline, ephedrine, or phenylephrine was diluted with Locke-Ringer's solution to give the desired concentration. At least two groups of five tracheal rings were observed at each concentration of each drug. The changes in ciliary movement of tracheal rings were noted after 5, 10, and 15 minutes' exposure to the vasoconstrictor.

RESULTS

The exposure of isolated tracheal ring segments to ephedrine, naphazoline, phenylephrine, or tetrahydrozoline in Ringer-Locke's solution at pH 7.2 resulted in an arrest of

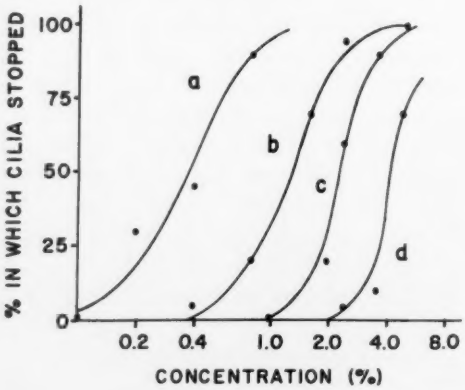

Fig. 1.—Curves relating percentage of rings in which ciliary movement stopped to concentration of the following vasoconstrictors in bath: (*a*) naphazoline, (*b*) tetrahydrozoline, (*c*) ephedrine, and (*d*) phenylephrine. Concentration in per cent on a log scale. Duration of exposure 15 minutes.

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From the Research Laboratories, Chas. Pfizer & Co., Inc.

Tyzine is the trademark of Chas. Pfizer & Co., Inc., for tetrahydrozoline.

ciliary movement. The number of rings in which the motility of the cilia ceased depended on the vasoconstrictor, its concentration, and the duration of exposure. In Figure 1, the results, in terms of the percentage of rings in which movement was stopped after 15 minutes' exposure to the drugs, were plotted against the logarithm of the concentrations of the vasoconstrictors. It can be seen that naphazoline arrested ciliary movement in the lowest and phenylephrine in the highest concentrations. Tetrahydrozoline and ephedrine stopped the movement of cilia at intermediate concentrations.

To make a quantitative comparison of the activities of these drugs which suppress ciliary motility, the concentrations necessary to inhibit movement in 50% of the rings exposed to them were estimated by the method of Litchfield and Wilcoxon.[5] These concentrations (IC_{50}) were 0.4% for naphazoline, 1.3% for tetrahydrozoline, 2.4% for ephedrine, and 4.2% for phenylephrine (Table 1). The 95% confidence limits of these values were also calculated.

TABLE 1.—*Ratios of Concentrations Inhibiting Ciliary Movement to Therapeutic Concentrations Causing Nasal Vasoconstriction*

Drug	Concentration Inhibiting 50% of Rings, Per Cent	Therapeutic Concentration, Per Cent	Therapeutic Index
	a	b	a/b
Ephedrine	2.4 (2.0-2.8)*	1.0	2.4
Naphazoline	0.4 (0.2-0.5)	0.1	4.0
Phenylephrine	4.3 (3.1-6.0)	0.25	17.2
Tetrahydrozoline	1.2 (0.7-1.5)	0.1	12.0

* The figures in parentheses are the 95% confidence limits.

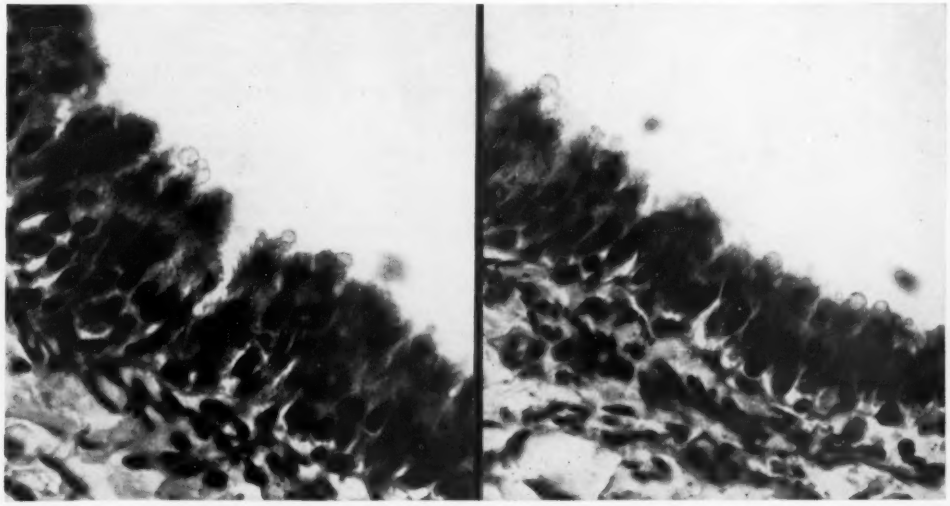
TABLE 2.—*Effect of pH on Ciliary Inhibition Produced by Tetrahydrozoline (2.4%)*

pH	Number of Rings	Per Cent Inhibition (5 Min.)	Per Cent Inhibition (10 Min.)
6.2	10	20	50
7.2	10	20	80
8.0	10	50	90

The concentrations of tetrahydrozoline which inhibited cilia in acid and alkaline media were also determined and are given in Table 2. It would appear that there is somewhat less depression of the ciliary movement of the tracheal rings in acid media than in neutral or alkaline ones.

In concentrations at which ciliary movements were arrested by the presence of the vasoconstrictors, globoid bodies formed on the surface of the ciliated epithelium. Figure 2 shows hematoxylin and eosin stained sections of tracheal rings exposed to 2.4% tetrahydrozoline. All stages in the development of these globoid bodies can be seen from the initial extrusion from the epithelial cell to the

Fig. 2.—Globoid-body formation following exposure to 2.4% tetrahydrozoline in Ringer-Locke's solution; pH 7.8; reduced ⅓ from mag. about × 900.



final spherical formation lying free of the tracheal mucosa.

COMMENT

As a measure of their local toxicity to epithelial surfaces, the effect of several vasoconstrictors on ciliary movement was studied. In considering the effects of substances on ciliary epithelium, account should be taken of the concentrations which are applied to the mucosa therapeutically. The therapeutic indices were thus calculated for each of the vasoconstrictors as the ratio between the concentration inhibiting ciliary movement and the concentration in which the drug is most commonly used as a nasal decongestant (Table 1). On this basis tetrahydrozoline and phenylephrine have the largest and therefore the most favorable therapeutic ratios.

The evidence from their staining qualities in hematoxylin and eosin sections was that the globoid bodies were cytoplasmic in nature. The extrusion of the globoid bodies was felt to be a physicochemical effect of the drug on the cell surface, causing a budding and finally the separation of a particle of its cytoplasm.

SUMMARY

The concentrations of several vasoconstrictors which inhibited ciliary movement and resulted in the extrusion of globoid bodies from the surface of rat tracheal epithelium were studied as a means of comparing their relative local toxic properties. When these concentrations were compared with those used clinically for nasal vasoconstriction, it was found that the resulting therapeutic indices were larger for phenylephrine and tetrahydrozoline than for ephedrine and naphazoline.

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Clorpactin WCS-90: A New Antiseptic

Preliminary Report

MARTIN ZWERLING, M.D., Bay Shore, N. Y.

For over a hundred years chemists have been attempting to use the powerful germicidal effect of chlorine as an agent in controlling infection. Recently a new group of agents have been developed, consisting of modified buffered hypochlorous acid derivatives, which appear to yield their active chlorine almost quantitatively as hypochlorous acid. Chemically they can be classified as monoxychlorosene * derivatives. This paper is a preliminary report of the use of Clorpactin WCS-90 in otolaryngology.

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From the Department of Otolaryngology, Southside Hospital.

* Clorpactin. The chemical data were obtained through the courtesy of the Guardian Chemical Corporation (Long Island City, N. Y.), which also supplied the material for clinical trial.

CHEMISTRY

Clorpactin is produced in various strengths, consisting of white, water-soluble powders or granules, whose dilute solutions are powerful germicides, fungicides, and virucides, yet are nontoxic and nonirritating when used in therapeutic dosages. These hypochlorous acid derivatives form dilute solutions with pH's varying from a highly acid 4.2 to substantially neutral, and are highly buffered. They are excellent oxidizing agents, effective deodorizers, and exhibit pronounced wetting, penetrating, and detergent properties. The grade of Clorpactin used in this study was Clorpactin WCS-90. A 0.2% solution of grade WCS-90 will retain sufficient potency over an eight-hour period, while the powder itself will retain

Therapeutic Results with Clorpactin WCS-90

Diagnosis	No Change	Improved	Much Improved
Acute simple pharyngitis	9	19	132
Chronic simple pharyngitis	6	13	91
Atrophic pharyngitis with atrophic rhinitis	2	2	5
Vincent's angina	0	0	8
Moniliasis (thrush)	0	0	6
Herpes of the pharynx	0	0	7
Paresthesias of the pharynx ("globus hystericus")	3	2	48
Acute tonsillitis	44	3	2
Chronic tonsillitis	38	2	3
Peritonsillar abscess	4	1	0
Catarrhal stomatitis	0	0	9
Aphthous stomatitis (canker sore)	0	1	18
Exanthematous stomatitis (chicken pox)	0	1	0
Stomatitis due to inoperable carcinoma (larynx)	0	7	2
Uvulitis	0	1	3
Dermatitis of the skin of the nasal vestibule	4	2	22
Furuncle of the nose	6	0	8
Cellulitis of the ear with perichondritis	0	0	1
Carbuncle of the neck	0	0	2
Acute rhinitis	18	3	4
Chronic rhinitis	28	1	2
Acute maxillary sinusitis (irrigations done)	0	4	17
Chronic maxillary sinusitis (irrigations done)	3	3	11
Oral antral fistula	0	0	2
Chronic infected granulations (radical mastoidectomies)	0	2	7
Total	165	67	410

its entire potency almost indefinitely, if kept under refrigeration.

MATERIALS AND METHODS

An unselected group of 642 otolaryngologic patients in whom a topical germicide was indicated were studied. A 0.2% solution of Clorpactin WCS-90, prepared by dissolving 2 gm. of Clorpactin WCS-90 in 1 liter of luke-warm tap water, was used. The solution was applied to the site of infections for five-minute periods, the solution being changed three to four times during that period.

RESULTS

The therapeutic results are summarized in the Table.

It is of interest to note the remarkable response of cases of "globus hystericus" to Clorpactin WCS-90. The probable explanation can be found in Morrison,[1] who feels that many of these cases of "globus hystericus" are really due to slight inflammation in a crypt or recess of the lateral folds, lingual tonsil, or hypopharyngeal recesses.

The most dramatic results were obtained in the treatment of aphthous stomatitis (canker sore). All 18 cases treated showed dramatic improvement within eight hours of application of Clorpactin WCS-90. These cases had been previously treated with various other medications for months and even years without significant effect.

The two cases of oral antral fistula closed within four days after irrigation with Clorpactin WCS-90. Previous irrigations with other solutions were ineffectual.

COMMENT

The activity of Clorpactin is based on its active chlorine content, principally as hypochlorous acid, acting in conjunction with the powerful wetting and penetrating qualities of the base, and stabilized and controlled by the specially developed buffers present. Clorpactin WSC-90 possesses bactericidal powers very similar to that of the elemental chlorine, yet it apparently does not have the toxic or destructive effect of the chlorines on tissue cells. At the present time Clorpactin WCS-90 can be administered only topically, depending upon contact with the particular fungus, bacteria, or virus for its germicidal action. The comparatively poor results in tonsillitis and rhinitis can be attributed to the fact that Clorpactin WCS-90 does not penetrate sufficiently to contact and destroy the pathogenic organisms in the depths of the tissue. Other grades of Clorpactin are at present being evaluated which seem to show greater penetrability.

Clorpactin WCS-90 has three definite advantages over antibiotics:

1. It is apparently nonspecific in its antibacterial action, having what appears to be a complete spectrum.

2. In the present series of 642 cases there were no indications of any untoward side-effects.

3. No resistant organisms were observed after extended use of Clorpactin WCS-90.

Further studies are at present in progress to determine the efficacy of Clorpactin WCS-90 in preoperative skin sterilization, instrument sterilization, and external otitis.

Another grade of Clorpactin, WCS-60, has been reported[2] to be effective in the treatment of oral lesions.

SUMMARY

A new drug, Clorpactin WCS-90, consisting of modified buffered hypochlorous acid derivatives was used topically in a series of 642 ear, nose, and throat cases. Tests show it to be a powerful germicidal, fungicidal, and virucidal agent, without significant toxic or irritating effects.

375 E. Main St.

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Otogenic Brain Abscess

Report of Two Cases with Unusual Clinical Features

MAURICE F. SNITMAN, M.D.
HARKISHEN SINGH, D.M.D., M.D.
JOHN H. GLADNEY, M.D.
and
JAMES R. SOFRANEC, M.D., Chicago

The occurrence of brain abscess secondary to ear disease while becoming infrequent in this antibiotic era can and does present itself. Our experience with these and other unreported otogenic complications is at great variance with the opinions of some clinicians who repeatedly emphasized their extreme rarity occasioned by the advent of antibiotic therapy. The patients under discussion presented clinical evidence of an acute exacerbation of a chronic otitis media, and the brain exploration took place subsequent to a mastoid exenteration, which in both cases disclosed pus under pressure in the mastoid cavity. The brain explorations took place within a five-day period coincidental with change of attending personnel (M. F. S. and H. S.). Because of some irregular clinical findings in two cases we wish to present in some detail their treatment and progress.

REPORT OF CASES

CASE 1.—H. A., a 30-year-old white man, was admitted to the hospital on June 20, 1954, with the complaint of headache of four days' duration associated with discharge from the right ear. The otorrhea had been present on and off for the past two years but had become especially active during the last two months. Since the onset of the discharge, he had noticed a progressive loss of hearing in the right ear, but no tinnitus or vertigo. On the day prior to admission, the patient began to experience excruciating pain in the right temporoparietal and postauricular areas and stated that his temperature rose to 104 F accompanied by chills.

Physical examination on admission revealed a well-developed, moderately obese 30-year-old white man who appeared lethargic. The temperature was 98.6 F, pulse rate 56, respiration rate 16, and blood pressure 122/72. The pupils were equal, responded symmetrically to light and in accommodation; funduscopic examination disclosed normal discs. A moderate amount of foul, purulent drainage was present in the right external auditory canal, and the tympanic membrane was partially obstructed from view by a small polyp which appeared to protrude from the anterior region of the pars tensa. The left ear drum showed evidence of a healed, chronic otitis media. The Rinne test was positive bilaterally and the Weber lateralized to the right ear. Neurological examination showed a slightly ataxic gait, but no pathological reflexes or signs of meningeal irritation were present. Laboratory findings: The white blood cell count was 13,600, with 87% neutrophiles and 13% lymphocytes. The red blood cell count was 5,150,000, urinalysis was normal, and serology was negative. Four days following admission, a spinal-fluid examination showed clear fluid with an initial pressure of 300 mm. of water with a cell count of 18 (predominantly lymphocytes). The spinal-fluid sugar was 62.5 mg./100 cc., chlorides 692 mg./100 cc., and total protein was 30 mg./100 cc. The serologic reactions were negative, and colloidal gold curve was 0011100000. A repeat white blood cell count showed 14,600 cells, with a differential count of 92% neutrophiles and 8% lymphocytes. A culture of the purulent discharge from the right external auditory canal showed Achromobacter organisms predominating with some hemolytic Staphylococcus aureus. X-ray studies showed sclerotic mastoids (Fig. 1).

On the fifth hospital day, a right radical mastoidectomy under general anesthesia was performed through an endaural approach. After removal of the mastoid cortex, thick greenish-yellow pus under pressure was encountered in the antral region. Cultures were later reported as showing Achromobacter as the predominant organism. The mastoid cavity was partially excavated by a cholesteatomatous mass which bordered on the tegmen mas-

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From the Veterans Administration Hospital, Hines, Ill., and the Department of Otolaryngology (Francis L. Lederer, M.D., Senior Consultant and Head of Department of Otolaryngology); Dr. Gladney and Dr. Sofranec, Residents in Otolaryngology, University of Illinois College of Medicine.

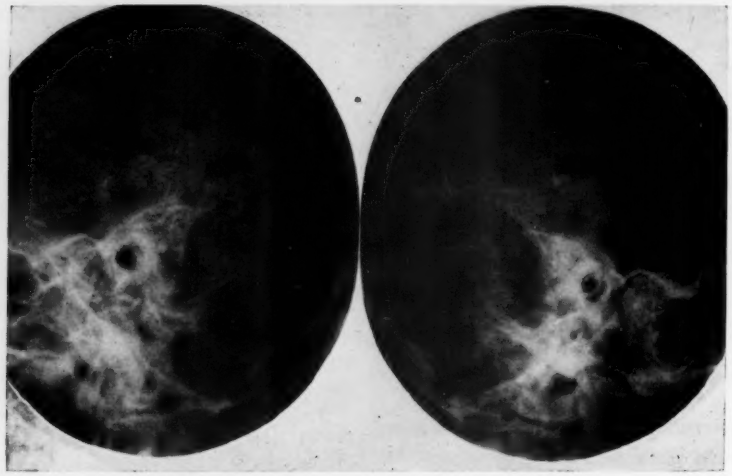

Fig. 1 (Case 1, H. A.).—X-rays of mastoids.

toideum. The dura was exposed surgically but not disturbed.

Postoperatively, the patient continued to exhibit somnolence and complained of severe right hemicrania. Four days later (June 29, 1954) papilledema was observed and, accordingly, intracranial exploration was indicated. Through a postauricular incision under local anesthesia, the mastoid cavity was reentered and the dural exposure enlarged. Significant changes of the dura were not present. A cruciate incision of the dura was made, and with a Cushing needle a large abscess was encountered at a depth of about 1.5 cm. Approximately 50 cc. of foul, purulent material escaped. The dural opening was enlarged to admit the small finger, and a finger cot drain was inserted into the abscess cavity, which did not give a feeling of encapsulation. Immediately following drainage the patient became more lucid, and in two days there was a slow and progressive stabilization of the vital signs. Large parenteral doses of oxytetracycline (Terramycin) were administered upon the advice of Neurosurgery. His maximum daily temperature was 99 F (Fig. 2). Although he showed a good response to oxytetracycline, on the sixth postoperative day chloramphenicol (Chloromycetin) was substituted, as tests showed the organism had become more sensitive to the latter. The drain was removed from the abscess cavity on the eighth postoperative day.

A 2+ papilledema on the right continued until the 13th postoperative day. On the 23rd hospital day the postauricular incision was closed secondarily under local anesthesia. Visual field studies two weeks following the second procedure were normal. Because of his lethargic state such studies were unobtainable prior to the drainage of the brain abscess. Approximately four months from the date of initial surgery, the patient was gainfully employed. The mastoid cavity was dry, with a fair preservation of hearing in the ear operated on.

Comment.—The signs and symptoms of intracranial pathology which were present prior to the first operative procedure, although due to an undiagnosed brain abscess, could have been those of an otitic hydrocephalus. With the findings of pus under pressure in the antrum, it appeared justifiable to the operator to delay brain exploration. The continuation of the somnolence and the development of papilledema without a repeat spinal-fluid examination indicated a brain exploration.

The isolation of Achromobacter organisms at surgery in almost pure culture on two occasions is not considered accidental or evidence of bacteriological contamination. To be sure, it is our opinion that these organisms represented virulent pathogens quite capable of producing the above clinical picture. Unpublished observations from the department of bacteriology at this hospital support this contention, as upon frequent occasions these have been discovered in certain treatment-resistant cases of osteomyelitis and chronic urinary tract infections. Achromobacter are Gram-negative motile bacilli that are generally classified as a nonpathogenic group of organisms. They are thought to be similar in their cultural characteristics to the Pseudomonas group of true bacteria.

CASE 2.—H. D., a 60-year-old white man, since childhood had intermittent discharge from his left ear associated with a marked decrease in his hearing. The otorrhea and earache usually followed an upper respiratory infection but at no time was there an associated vertigo or tinnitus. On May 28, 1954, his temperature rose to 104.4 F accompanied by pain and tenderness over the left mastoid region. His family physician administered penicillin daily for five doses and the temperature receded. Because of persistence of pain and ear discharge he entered Hines Hospital on June 3, 1954.

Physical examination revealed a well-developed, well-nourished white man in no acute distress, who was cooperative and mentally alert. Temperature was 99 F. The left external canal was partially filled with purulent material, and a large polyp obscured visualization of the tympanic membrane. There was slight tenderness on moderate pressure over the left mastoid process. Hearing was limited to conversational voice ad concham on the right ear. The Weber test lateralized to the right and the Rinne was positive on the right and negative on the left. Reflexes were physiological.

X-rays of the mastoids (Fig. 3) on admission revealed a marked increase in the bone density of the antral regions and the mastoid tips, more pronounced on the left. The cellular septa were obliterated. There appeared to be an area of radiolucency above and behind the canal on the left side. Impression: bilateral mastoiditis with a suggestion of bone destruction on the left side, indicating the presence of a cholesteatoma. Spinal puncture revealed the fluid under normal pressure with 8 cells per cubic millimeter. Sugar was 38 mg./100 cc., protein 95 mg./100 cc., chlorides 655 mg./100 cc., and the Ross-Jones test was positive. The serologic reactions were negative. The white blood cell count was 12,200, with 89% neutrophiles and 11% lymphocytes. The red blood cell count was

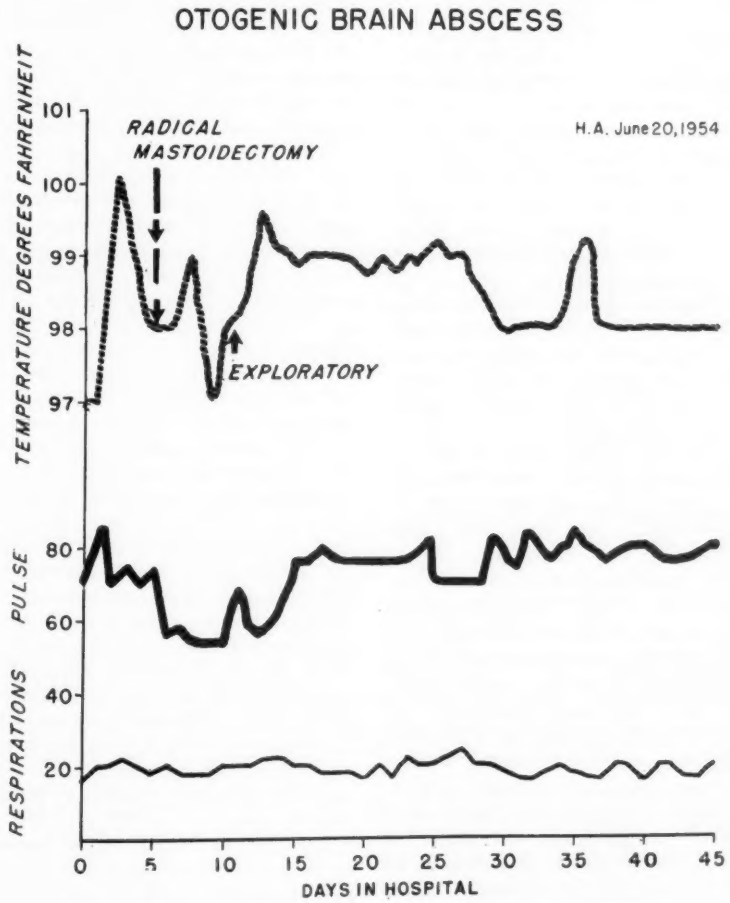

Fig. 2 (Case 1, H. A.).—Temperature, pulse, and respiration.

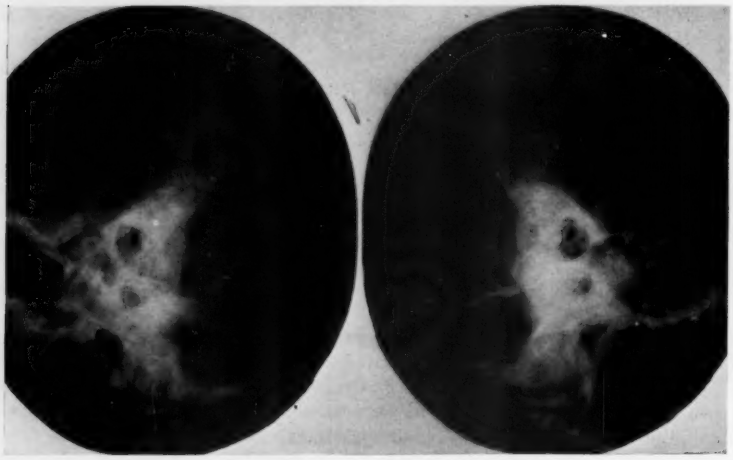

Fig. 3 (Case 2, H. D.).—X-rays of mastoids.

4,900,000 with 15 gm. of hemoglobin. Urinalysis was negative.

Penicillin was administered parenterally and followed several days later by tetracycline (Achromycin) because of unsatisfactory clinical response. The temperature continued to be septic (Fig. 4); however, a blood culture was negative. Repeat white blood cell count showed 25,700 cells, with 91% neutrophiles, 6% lymphocytes, and 3% monocytes. Surgery on the mastoid was advised. On June 15, 1954 (12 days following admission), under general anesthesia a left radical mastoidectomy was performed. At operation the antrum contained pus under pressure and was partially filled by cholesteatoma. A dehiscence in the tegmen mastoideum was found, but the exposed dura appeared grossly normal. Culture of the purulent discharge revealed E. coli, most sensitive to streptomycin, chloramphenicol, oxytetracycline, and penicillin. Within two days following surgery his temperature returned to normal and remained so for two weeks. The patient was up and around and entirely asymptomatic on the seventh postoperative day. Visual field studies and fundi examination on three occasions showed no abnormalities. During the 14th postoperative day, his temperature rose to 100.2 F and he complained of pain in the left ear. He appeared mentally confused and had difficulty in naming simple objects, displaying monophasia. At this time another funduscopic and a visual field examination were still normal. The white blood cell count was 11,000, with 81% neutrophiles and 19% lymphocytes. Neurosurgical and neurological consultations were obtained, and a tentative diagnosis of a thrombosis of the left middle cerebral artery was made. His temperature returned to normal, remaining so for three days and then rose again to 103 F. Accordingly, another spinal puncture was performed, on July 2, 1954 (18 days postoperatively), revealing an opalescent fluid with a pressure of 400 mm. of water. The cell count was 12,000 white blood cells, with 99% neutrophiles and 1% lymphocytes. The spinal-fluid sugar was 20 mg./100 cc., chlorides 106 mg./100 cc., total protein 200 mg./100 cc., and a colloidal gold curve of 0012211000. A hemogram showed a white blood cell count of 11,000, with 81% neutrophiles and 19% lymphocytes. Following the spinal-fluid puncture a transient paresis of the right upper extremity occurred but disappeared in six hours. The following day, under local anesthesia, the mastoid cavity was opened through a postauricular incision and the tegmen mastoideum widely removed. The dura bulged slightly and was moderately tense. A cruciate incision was made in the dura and a Cushing needle introduced upward into the temporal lobe. At a distance of about 2.5 cm., thick, purulent, odorous exudate escaped under pressure. Cultures at a later day from this exudate showed E. coli which was sensitive to streptomycin, chloramphenicol, oxytetracycline, and penicillin. After evacuation of about 60 cc. of purulent exudate the dural incision was enlarged to permit the entry of a small finger. A large Penrose drain was placed into the abscess cavity, which, similar to Case 1, did not possess an identifiable capsule. The patient immediately appeared more lucid and was oriented in all planes. He received intravenous oxytetracycline for three days, and after the report on culture sensitivity chloramphenicol was substituted and maintained for 20 days. This was followed by the oral administration of oxytetracycline for 21 more days. The drain was removed on the seventh postoperative day.

The postoperative course was uneventful, and a secondary closure of the postauricular incision was performed on the 33rd postoperative day. The patient was discharged asymptomatic on the 71st day.

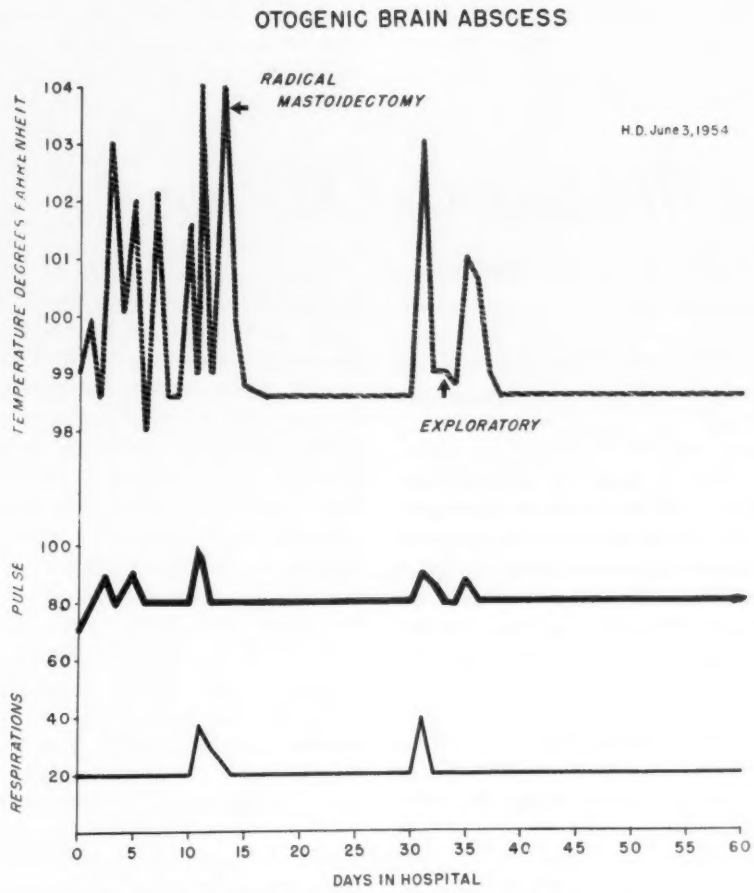

Fig. 4 (Case 2, H. D.).—Temperature, pulse, and respiration.

Comment.—Despite the presence of an undiagnosed brain abscess, this patient returned to apparent normalcy following mastoid drainage. The absence of clinical findings of intracranial pathology may be ascribed to the masking effect of antibiotic therapy. After the belated rise in temperature, a monophasia, and pain in the head, surgery was delayed for two days because of a consultation impression of rupture of the left middle cerebral artery. However, exploration was mandatory following the pronounced spinal-fluid findings.

SUMMARY

Two cases of brain abscess are presented, each of which followed an acute exacerbation of chronic otitis media. The clinical picture was unusual in that the signs and symptoms did not fully conform to the intracranial pathology. In the first case, the continued somnolence and the development of papilledema were considered justification for a brain exploration. The organism, Achromobacter, isolated by culture of the brain abscess is discussed. The postoperative recovery was excellent. In the second case, there was present more evidence of intracranial extension. The septic course and monophasia and memory lapse, plus the pronounced spinal-puncture laboratory findings, justified brain exploration. The postoperative course and therapy are outlined.

Stapes Mobilization in Otosclerosis

Primary Results and a Review of Sixty-Three Cases

YRJÖ MEURMAN, M.D.
and
OTTO MEURMAN, M.D., Helsinki, Finland

INTRODUCTION

During the last seven or eight decades great advances have been made in the surgery of otosclerosis. In the light of its most recent phase—stapes mobilization—it is of interest to recall that the earliest attempts to correct the hearing loss due to this disease were also aimed at remobilization of an ankylosed ossicular chain.

HISTORICAL REVIEW

Kessel (1876) suggested mobilization in ankylosis of the stapes even before the actual nature of otosclerosis was known—at a time when the disease was considered a kind of dry sclerosis of the middle-ear mucosa. Michel's * report dealing with mobilization of the stapes dates from the same year. Boucheron † (1888) separated the incus and the stapes from each other and then tried with a special hook to render the latter mobile in the oval window. In some cases he obtained good results in the incipient stages of the disease. Miot ‡ (1890) obtained improvement in hearing in 28 cases of 56. In many cases he had to mobilize the stapes several times.

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From the Oto-Laryngological Clinic, University of Helsinki (Head Professor, Y. Meurman).

* Michel, quoted by Engström.

† Boucheron, quoted by Engström.

‡ Miot, quoted by Engström.

However, the attempts of that time were not limited to mobilization alone. It became a very usual procedure to remove the malleus and incus through an incision of varying size in the tympanic membrane. Often the stapes was left undisturbed intentionally. Lucae (1885), for example, reported the following results with this method: In 53 cases operated on, considerable improvement in hearing was obtained in 9, some improvement in 19, no improvement in 18, and deterioration of hearing in 7. Stapes extraction was also performed by numerous otologists, both in Europe and in the U. S.

Operations of this kind were usually made under chloroform anesthesia, but cases have also been reported in which an unanesthetized patient bore the pain of the operation with stoic fortitude. Taking into account the difficulties experienced at that time in obtaining hemostasis, the primitive lighting conditions, the lack of an operating microscope, and the inability to prevent postoperative infections, it seems astonishing that the results reached with those methods were even good enough to encourage further attempts.

In the 1890's, however, more and more objections to this operation were raised. The chisel was now directed at the semicircular canals instead of being used upon the ossicular chain. The era of the fenestration operation had dawned. A description of its evolution is not called for in this connection. The names of the Big Three of fenestration surgery, Holmgren, Sourdille, and Lempert, are known to all.§

§ A detailed description of the earlier development of otosclerosis surgery can be found, for example, in Engström's article.

New vistas were opened up in the surgery of the ear by the improvements in the technical adjuncts required at operation, chiefly lighting and magnification. Thus Herberts stated, in 1947, that the time was ripe for new attempts in the area of the stapes. After demonstrating on cadaver material that the membrane covering the inner surface of the stapedial footplate is thicker than usual in otosclerosis, he exposed the middle ear in two patients through the mastoid process and removed the stapes, leaving the membrane in situ. The primary results were good. It has not come to our knowledge whether they were permanent. The technical difficulties probably were considerable, and the operation did not gain favor. In addition, this operation results in interruption of the ossicular chain, and thus, even in theory, the improvement in hearing cannot be greater than by the fenestration operation.

Quite contrary to previous attempts, the most recent method in the field of otosclerosis surgery, Rosen's stapes mobilization, is based on the creation of as normal conditions as possible, on preservation of the tympanic membrane and the ossicular chain, and on remobilization of the stapes in the oval window.

Otosclerotic Process in the Window Region

Before dealing more closely with the operative technique and the results obtained, it is well to consider the otosclerotic process in the window region in particular and the theoretical possibilities for remobilization of the stapes.

In otosclerosis sharply delimited, richly vascular areas of periosteal bone develop in the enchondral layer of the bony wall of the inner ear, owing to factors as yet unknown. The most usual site of these areas is right in front of the oval window, but they are found also elsewhere. In Nylén's series otosclerotic areas occurred in 90% of the cases anterior to the oval window, in 40% in the round-window region, and much more seldom in other locations. In only 8% were such areas present in the round-window region alone. According to Guild, the otosclerotic lesions in the round-window region only seldom become large enough to occlude the whole window or influence the hearing otherwise. Nager and Fraser reported on six patients with extremely large otosclerotic areas in whom the scala tympani of the cochlea was ossified as well. In only two of these there was complete closure of both windows. Recently Lindsay and Hemenway reported their histological observations on a woman of 35 years with an otosclerotic area in the region of the round window only. Ossification involved 80% of the window membrane. In spite of this the patient was known to have had entirely normal hearing until death. Even a small free area in the membrane of the round window thus suffices to produce the vibration required for normal hearing. Wever came to the same conclusion in his studies on cats. Hearing was not reduced until there was complete blockage of the round window. Closure of the oval window with involvement of the round window must thus be regarded as fairly unusual, and closure of the round window alone as even more so.

The otosclerotic areas anterior to the oval window grow to its margin and from here through the annular ligament to the footplate of the stapes, with the result that the mobility of the stapes is impaired and finally ceases entirely. The extension of these areas as they grow through the annular ligament to the stapes varies greatly. Thus Covell found that in 15 of his 31 cases of stapes ankylosis there was very extensive fixation of the stapedial footplate. In these cases the process often spread somewhat farther, to the crura of the stapes. In the remaining 16 cases, however, the extent of fixation was very small; usually it occurred at the anterior margin of the window. Guild's series of 10 histologically verified cases of stapes ankylosis included none in which ossification involved the whole circumference of the window. Usually less than half of it was involved. At times there were several narrow bony connections between the footplate of

the stapes and the window margin, the rest of the ligament being entirely normal.

The above histological observations thus clearly indicate that fixation of the stapes to the oval window may be of highly varying character. Tobeck, for example, arrived at the same result clinically: Palpating the stapes with a probe, he studied its fixation by the aid of a microscope during fenestration. Occasionally a distinct though slight movement was observed with respect to the long axis of the stapedial footplate. No movement was observed with reference to the short axis, that is, in the longitudinal direction of the footplate. In most cases, however, the fixation was clinically total. The audiograms in these different cases of bony fixation did not vary: They indicated complete fixation in all cases.

Theoretically there should thus be possibilities of loosening the stapes, in other words, of breaking the bony connection, especially in those cases in which this latter is only narrow. The greater its extent, the more difficult is mobilization. It is clear that there must of necessity be many cases in which the resistance of the bony connection is greater than that of the weak crura of the stapes, and attempts at mobilization by pressure against the neck of the stapes will then result in fracture of one or both crura. The fact that the crura fracture easily was noted, for example, by Cawthorne when he extracted the stapes from the oval window in cases of fixation. The stapedial footplate also often was broken before being loosened from the oval window.

The question of the reossification of a mobilized stapes is also interesting. Rosen's results show that the stapes may remain mobile for at least two years after mobilization. Why does the fractured bridge not become ossified again? It is common knowledge that the inner-ear wall, differing in structure from all other bones of the human body, is extremely resistant to the healing of fractures. Thus Wolff, for example, in studying cases of otosclerosis histologically, noted fissures in the inner-ear wall which she considered to be spontaneous. It is possible that otosclerotic lesions also have such a poor tendency to healing. We know further, on the basis, for example, of Guild's and Nylén's studies, that so-called active and silent foci can be differentiated histologically. Fractures in the latter may also have a poorer tendency to heal. A possible third factor is that the footplate of the stapes is in a state of constant slight vibration, which might tend to prevent union of fractures. In other words, this would be a kind of pseudarthrosis phenomenon.

What has been stated above has aimed at demonstrating that mobilization of the stapes has a sufficiently firm theoretical basis in clinical otosclerosis. The results obtained by this operation will be dealt with below.

OUR OWN INVESTIGATIONS

Technique

For a description of the technique the reader is referred to Rosen's paper. We have mainly followed his advice, and as soon as his original instruments were available we began to use them. Before that we mobilized the stapes with an instrument consisting of a thin shaft with a needle-like end bent in an obtuse angle of about 130 degrees. The bent end was pressed against the neck of the stapes. Afterward Dr. Rosen presented us a new mobilizer with a shorter arch at the tip.

During this work we have learned to heed some special points. It is important to make the incision in the canal wall, as Rosen advises, sufficiently lateral to the drum, more than 5 mm. from the margin. Otherwise an open slit may result at the annulus. The magnification requires special attention. The operation can be performed with a binocular loupe, magnifying 2½ to 3 times, as by Rosen. It is a disadvantage that, when working through an ear speculum, binocular vision is much hampered. However, when the latest model of the Zeiss binocular microscope is used, binocular vision is unimpeded.

TABLE 1.—*Age Classification of Patients*

Age, Yr.	Patients, No.
20-24	6
25-29	11
30-34	8
35-39	9
40-44	10
45-49	14
50-54	..
55-59	4
60-64	..
65-69	..
70-74	1
Total	63*

* Women, 46; men, 17.

In addition, the more powerful magnification obtained with it is a valuable asset. Besides other observations, to which we shall revert later in this article, the checking of the mobility of the stapes after mobilization is considerably facilitated. We generally work with × 6 magnification, but even × 10 and × 16 are useful and sometimes of great help.

At the beginning, before becoming familiar with the funnels used by Rosen, we widened the outer portion of the meatus with a straight incision, at about 12 o'clock, as for fenestration—but only from the border of the bony meatus outward. An écarteur was then inserted to spread the orifice. In the course of the work we have mostly omitted the incision, though it may be required quite exceptionally.

MATERIAL

Up to the middle of October, 1954, our material consisted of 63 patients. The operations were performed by both of us, about an equal number by each, five by Dr. Rosen, and five by Docent Vaheri. The age of the patients varied from 20 to 74 years, as shown in Table 1. There were 46 women and 17 men. According to hearing acuity, they could be divided into three groups. In the most suitable group, Group A, the pure-tone audiogram showed an air conduction between 30 and 60 db. Bone conduction was not lower than 25 db. There was no lowering at the high frequencies. Also, in Group B the air-conduction hearing loss did not as a rule exceed 60 db. Between 2000 and 4000 cps bone conduction declined to 30 db. or somewhat lower, being, however, distinctly higher than air conduction. The cases of Group C showed an air-conduction curve lower than 60 db. The loss in bone conduction was greater than in Groups A and B, and there was a further decline toward the higher frequencies. Thus the suitability of the cases in this group was to some extent doubtful. They were predominantly included for examination of the motility of the stapes footplate. Table 2 shows the distribution of cases in the three groups. It appears that in more than two-thirds a favorable result could be expected.

TABLE 2.—*Cases Classified by Audiogram*

Group	No. of Cases
A	40
B	16
C	7
Total	63

TABLE 3.—*Hearing After Mobilization*

	Hearing		
Group	Good	Slightly Improved	Unchanged
A	19	5	16
B	5	4	7
C	1	3	3
Total	25	12	26

Improved: 37 (58.7%).

RESULTS

The results of mobilization are shown in Table 3. The number of improved cases in Group A is three-fifths of the whole group. Of these almost four-fifths obtained good hearing, whereas the improvement in the remaining one-fifth was slight. In the less favorable groups the proportion of the improved to the unimproved is somewhat less favorable, but there was improvement in more than half. The comparatively great number of failures seems perhaps surprising. We shall discuss this outcome later.

One might expect the hearing to reach its eventual level within a short time after

TABLE 4.—*Average Hearing Improvement Calculated from the Frequencies 500, Between 250 and 4000 Cps*

Hearing Improvement	Group A	Group B	Group C
Less than 20 db.....	12	7	3
More than 20 db.....	12	2	1
Total.....	24	9	4

Maximum mean improvement: 52 db.

TABLE 5.—*Postmobilization Hearing Level as Calculated from at Least Three Frequencies Between 250 and 4000 Cps.*

Hearing Level, Db.	Group A	Group B	Group C
0.....	..	..	..
5-10.....	2	..	..
15-20.....	7	..	..
25-30.....	9	2	..
35-40.....	4	4	1
45-50.....	1	2	1
55-60.....	..	1	2

mobilization. The drum membrane in some cases regained its ordinary appearance in almost 10 days. In some others the return to normal took a longer time. The time taken for the hearing improvement to reach its final degree varied considerably. There were cases in which this lasted about four weeks, although in many others this time was much shorter.

The time of observation in our cases was short, and it is quite natural that we cannot report any permanent results in terms of hearing improvement. Yet in none of these cases did an impairment follow when the improvement had once reached a maximum. The gain in hearing is shown in Table 4. We have taken an improvement of 20 db. as the borderline. Looking at Table 4, we find that exactly half of the most suitable cases have an improvement of less than 20 db. while the other half have 20 db. or more. Those gaining more than 20 db. include several with considerably greater improvement, for example, one with an average maximum of 52 db.

The level of hearing after mobilization is seen in Table 5. Two patients attained a 5 to 10 db. level as calculated for at least three frequencies between 250 and 4000 cps. Seven others rose to the 15 to 20 db. level. Such results are hardly ever obtained by fenestration. Nine patients in Group A and two in Group B reached the level of good practical hearing (25 to 30 db.) corresponding to the requirements after fenestration. The changes in bone conduction after mobilization will be studied further and will be dealt with in a later article.

Two typical audiograms of successful cases (Figs. 1 and 2) are shown here. One of them illustrates clearly that advanced age is no contraindication to this operation.

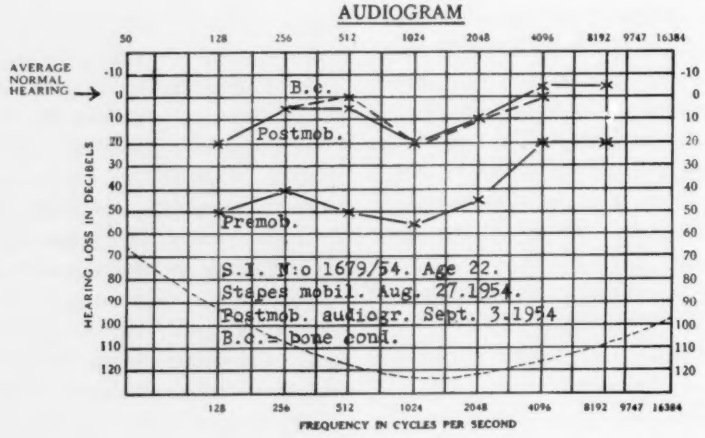

Figure 1

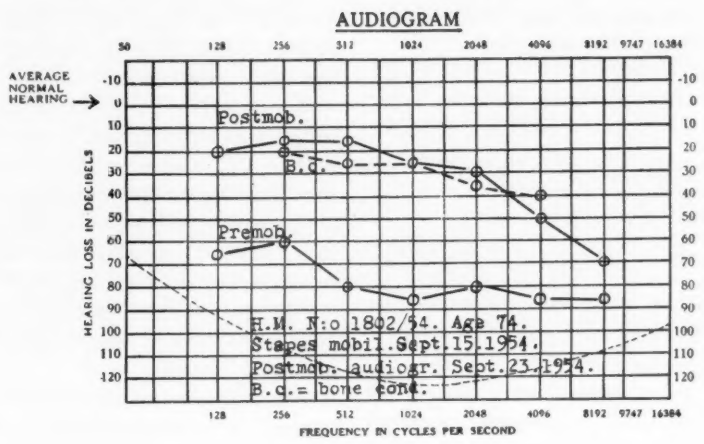

Figure 2

COMMENT

Grade of Stapes Fixation

As stated above in the introduction, fixation of the stapes to the oval window can be of highly varying character. This we noted also during operation. In some cases even slight touching of the neck of the stapes rendered it mobile; in others mobilization was not successful until powerful and prolonged pressure was applied. The firmness of fixation seemed to be unrelated to the duration of hearing loss. In some of the cases with a history of years, even decades, of impaired hearing, the stapes loosened easily; in others with a history of at times only one or two years the stapes was extremely firmly fixed. Table 6 shows the hearing improvement in 45 cases in which special attention was paid to the firmness of fixation. In two-thirds there was distinct improvement when the stapes was easily mobilized. When it was firmly fixed, hearing improved in only half the cases.

Table 6.—*Stapes Fixation and Improvement in Hearing*

Stapes Loosened	Cases with Hearing Improvement, No.	Cases with No Hearing Improvement, No.
Easily	21	10
With difficulty	7	7

Total: 45 cases.

The Round Window

One of us (O. H. M.) made an interesting observation with reference to the round window. In cases in which some fluid, either saline, penicillin solution, or a small amount of blood, had remained in the round-window niche, movement of the fluid surface was observed when the mobilized stapes was moved with an instrument. This, of course, shows better than anything else that the stapes has been rendered mobile again and that the vibrations in the perilymph continue up to the membrane of the round window. Later both of us several times were able to visualize even the round-window membrane in the niche. So far as we know, the general conception has been that the membrane is covered by the anterior border of the niche in such a way that it cannot be viewed through the meatus. We have not yet made a record of those instances in which it was visible, but the number is not small. Certainly observation of the movement of occasional fluid or of the membrane itself is greatly facilitated when using higher magnification: It is not easy to observe these phenomena with lenses magnifying only two or three times. On the other hand, there are cases in which simultaneous manipulation of the stapes and observation of the round-window niche is difficult.

One expects, of course, that when a mobilized stapes is moved and simultaneous

TABLE 7.—*Observation of Round-Window Membrane in Nineteen Cases*

	Cases with Hearing Improvement, No.	Cases with No Hearing Improvement, No.
Movement of Stapes Caused:		
Vibrations	10	1
No vibrations	1	7
Total	11	8

movement of the round-window membrane is observed, the hearing has improved. Table 7 proves this. As these observations were not made in the beginning of the series with operation, the number of observed cases is at present still fairly small. Also, as mentioned already, such observation is not always possible. In our subsequent material we have always tried to heed this phenomenon. In Table 7 attention is aroused by the case in which, in spite of vibration of the round-window membrane, hearing did not improve. The probable cause of this was the impaired mobility of the rest of the ossicular chain. The case in which hearing improved although no vibration could be observed is evidently to be included among visual errors. There were seven cases in which neither vibration of the round-window membrane nor improvement of hearing was observed although the stapes was mobile; these—at least most of them—must be attributed to fracture of one or both crura, to which we will revert later in this article.

COMPLICATIONS

Some complications may occur during the operation. The mobilizer must be handled with utmost care. Even then it may occasionally happen that the point of the mobilizer slips upward, tears the capsule of the joint, and luxates the long process of the incus from the head of the stapes. In some cases the stapes is at the same time mobilized. Then the accident has not caused great damage; it is often possible to place the joint surfaces in the right position.

Another accident, which is not rare, is rupture of the tympanic membrane. Most of these were small ones. In some cases the cause may have been an atrophic scar, but sometimes the drum was at least apparently normal. Most frequently the rupture was in the lower posterior quadrant, but it may appear anywhere in the posterior or inferior half. Such a rupture, if it is not small, results in a persistent perforation. In the cases with mobilized stapes it impairs the hearing improvement considerably. In unsuccessful mobilization it is a harmful result. Quite small perforations healed under the cover of cigarette paper or even without it. Larger ones were repaired according to the Zöllner method.

We experienced two cases of facial palsy. In the first the stapes could not be mobilized. The palsy healed within two months. Fenestration was then done. At operation it was observed that the nerve lacked bony covering in the aditus. The second palsy, which was very slight, appeared without any apparent cause one week after mobilization and passed in two days. One may take these palsies calmly if the instruments have been manipulated with proper care. No serious damage can then be inflicted on the nerve. The above accidents are recorded in Table 8.

In Table 8 we have not included the cases in which a crus or both crura were broken. The reason for this is that a quite definite statement of this accident is not easy, since in most cases the crura do not come into view. But as this accident has a certain relation to the number of unsuccessful cases, it will be discussed togther with the failures.

FAILURES

In Tables 3 and 6 are given the percentages of cases with improved hearing in this series: 58.7 and 62.2. Compared with the results of fenestration, the successful results are somewhat poorer. The chief cause of the failures certainly is fracture of one or occasionally both of the crura. It is easy to un-

TABLE 8.—*Accidental Complications at Mobilization*

Complications	Cases, No.
Luxation of incudostapedial joint	13
Rupture in pars tensa	14
Facial palsy	2
Total	29

derstand that in cases of firm fixation the anterior crus, which is thinner, or both crura are broken. Such was evidently the state of things in most of the seven cases of Table 6 which did not result in hearing improvement. Powerful pressure was followed by fracture of a crus. But 10 cases in the same Table—which were also failures as far as hearing improvement is concerned—show that even a slight touch may cause fracture of a crus and thus make the stapes apparently mobile, but naturally without any hearing gain. This probably was due to the direct effect of the otosclerotic process on the junction of the stapes plate and the crus or on the crus itself. As in the case of fenestration operations, failures due to an ossified round-window membrane must be extremely rare. Another factor pointed out by Rosen, namely, stiffening of the joint between the malleus and the incus, may be present. At present it is difficult to assess the frequency of this condition. It certainly requires larger material and further experience. This factor, of course, has no bearing on the failures after fenestration, as the incus is removed.

Rupture of the drum depresses the level of improvement distinctly. However, this impairment varies greatly from case to case. In some the patient at once notices distinct improvement at the stage of the operation when the drum is still folded upward, whereas in others a distinct difference in hearing is not observed until the drum is put back into its proper position. As already stated, hearing often improves gradually during the weeks succeeding the operation. These observations may be expected to throw added light on the problem, but they must still be studied consistently.

CONCLUSIONS

The question now arises: Is it worth while trying mobilization when the fenestration operation gives a higher percentage of cures? Even with our limited experience we are inclined to answer this question affirmatively. The following reasons justify mobilization:

1. The improvement will in many cases exceed that attained by fenestration.
2. Mobilization is a much smaller surgical procedure.
3. Little if any after-treatment is required.
4. In unsuccessful cases fenestration can be performed afterward.

On the basis of these arguments mobilization is an operation which should, as a rule, be tried first. On the other hand, fenestration can be resorted to in those cases where mobilization has failed. Thus the fenestration operation will always preserve its value.

Many otologists have doubted the permanence of the results of mobilization. Up to the present our experience is too short to demonstrate permanent mobility of the stapes. Yet during this period of about six months we have not observed a single case in which the stapes would have become fixed again. Rosen has had some successful cases under observation for up to two years. It is clear that we cannot be convinced of permanent success until the number of cases reported has increased. But even assuming that reossification occurs in a certain number of the mobilized cases, the operation can, nevertheless, be recommended: There is nothing to prevent trying it again, and theoretically it ought to be as easy to perform as the first time.

Rosen in his papers pointed out some important technical details, and we want to confirm them, in our turn, on the basis of our experience:

The incision line in the wall of the meatus must be placed more than 5 mm. lateral to the drum margin. The soft covering of the meatus has a tendency to contract, which may result in a slit at the border of the tympanic cavity.

In order to avoid rupture and permanent perforation the lining of the meatus must be freed very slowly and carefully.

Mobilization of the stapes must be carried out with utmost caution, preferably with repeated even pressure, and not by jerky movements.

We wish to add two more points which we have found of importance:

It is highly advisable to observe the round-window niche for any detectable movements

while moving the stapes. If such movements are seen, they ensure a positive result.

A binocular Zeiss microscope of the new model is of invaluable aid both in working and for observation.

We thus advocate stapes mobilization in cases of otosclerosis. On the other hand, we realize that, as regards the number of cures, this operation has not so far given as good results as might be desired. The causes of failure must be submitted to further examination. There may be technical factors which perhaps can be avoided. Insufficient observation during the surgical procedure may be another cause. As an example, we mention the case of a patient who was admitted for subsequent fenestration, on which occasion it was found that the stapes was not mobilized. Moreover, we have thought of a possibility of modifying the technique. In any case, the Rosen mobilization has attacked the surgical treatment of otosclerosis from a new angle and given us new opportunities of developing the therapy of this ailment.

The following point still calls for consideration. There are cases with an uncertain diagnosis of otosclerosis. Very few otologists would be ready to submit these patients to fenestration. Yet these are the patients who are very suitable for examination by an operation which exposes both windows. Adhesions can hereby be liberated, a closed round-window niche reopened, and bands of connective tissue fixing the stapes severed. Such a diagnostic surgical procedure will, no doubt, be common in the future.

SUMMARY

The primary results obtained in 63 patients operated on according to Rosen's method are reported. The number of cases in which improvement in hearing was obtained, as well as the degree of improvement, is presented. The complications and the factors that may be responsible for failures are then discussed.

Haartman'ink. 4.

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The Structure and Function of the Nasal Vestibule

MAURICE H. COTTLE, M.D., Chicago

The vestibule of the normal adult nose is a specialized organ with very characteristic structures and specific functions and is the beginning of each nasal passage. Here the respiratory tract makes its first contact with the outside world of air.

The vestibule is surrounded almost entirely by its half of the nasal lobule, bounded laterally by the ala, or wing, medially by the mobile septum and columella, superiorly by the cul-de-sac and limen vestibuli, and posteriorly by the skin lying on the alveolar process of the superior maxilla. Its inferior limitation is the nostril (external naris). Anteroinferiorly, it becomes a recess behind the nasal tip, called the atrium or ventricle. Extending into the vestibule from above and in front is the ipsolateral upper lateral cartilage, which is the terminal lateral portion of the cartilage vault (the roof cartilage), which is usually attached by fibrous tissue to the accompanying terminal portion of the cartilaginous septum. The vestibule is also encroached upon by the ends of the lobular cartilage (alar cartilage); the medial portion of the cartilage—the medial crus—curves laterally, usually at the junction of the posterior and the middle third of the columella, producing with its fellow the typical widening of the base of the columella (Fig. 1*A*). The laterocaudal border of the lateral crus of the lobular cartilage protrudes into the vestibule medially carrying with it a substantial fold of hair-bearing skin (Fig. 1*B*). The cartilage here is normally moderately concave from within and lies lateral and superior to the terminal portion of the upper lateral cartilage; it is lined with a nonhair-bearing skin. The space between the upper lateral and the lower lateral (lobular) cartilages is a well-formed cul-de-sac, sometimes called an infundibulum or a diverticulum (Fig. 2).

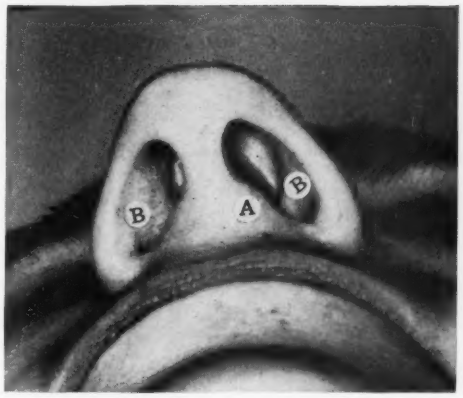

Fig. 1.—Normal widening of base of columella (*A*) produced by ends of medial crura. Hair-bearing skin (*B*) drawn across vestibule by lateral crura.

The lateral crus protrudes into the vestibule about 5 mm. superior to the protrusion of the medial crus. The cul-de-sac is still more superior. The upper lateral cartilage usually makes an angle of 10 degrees with the septum just under the septum roof and moves to and from the septum with the respiratory air currents, and thus acts as a valve (Fig. 3). It is prevented from completely collapsing on inspiration by its tendency to curl away

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From the Chicago Medical School and the Cook County Graduate School of Medicine.

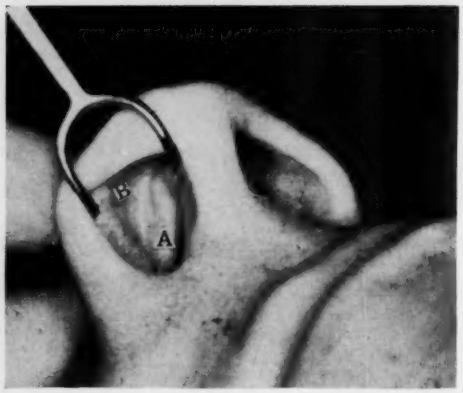


Fig. 2.—"Cul-de-sac"—space between upper lateral cartilage *A* and lateral crus of lobular (alar) cartilage *B*.

from the septum and by its connective-tissue attachments to the lateral crus of the lobular cartilage. The effect of the latter becomes augmented by the dilatation of the nostrils, which results from the action of the dilator muscles of the alae. The opening of the nasal valve on expiration is accomplished by the passage of the air. Depression of the tip of the nose through the action of the depressor muscles of the mobile septum can often enlarge the valve opening.

The portion of the lobular cartilage joining the medial and lateral crura is known as the dome or the knee of the cartilage; it is usually notched inferiorly and bent quite sharply. With its fellow lying in juxtaposition, it forms the nasal tip. Variations in the angulations of the domes and their fibrous junctures to each other are very many and are subject to congenital and traumatic influences.

Fig. 3.—Lateral view of left valve area after skin removal and elevation of left vestibule.

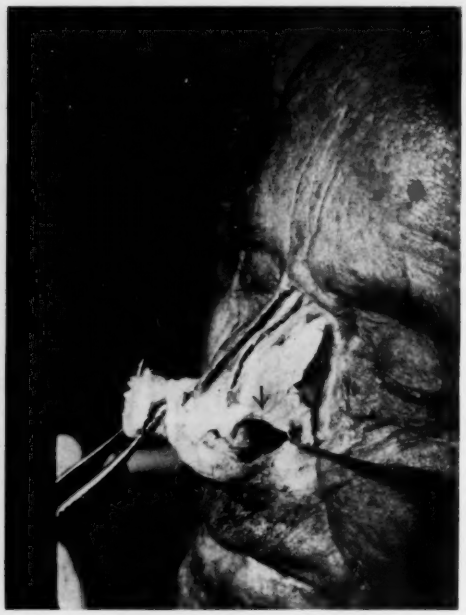


Fig. 4.—Looking towards nasal tip from within the nose. Arrow points to the ventricles beneath lobular (alar) cartilage.

The tip harbors in each of the vestibules (as already mentioned) the recess just anterior to the nostril, the atrium, or ventricle (Fig. 4).

The posterior wall of the vestibule inferiorly is, in a white adult, not usually continuous with the floor of the nasal chamber proper, but instead is encroached upon by the inferior portion of the pyriform crest (Fig. 5).

This whole complexity of structures screened in the adult with more or less dense

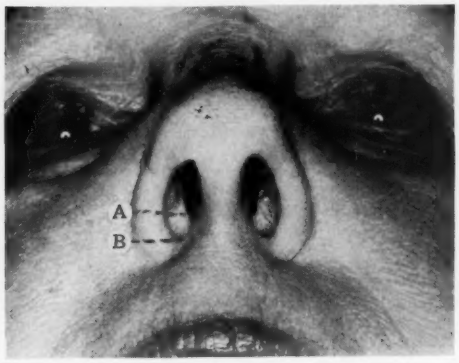


Fig. 5.—*A*, floor of pyriform crest; *B*, floor of vestibule. (Note vertical Caucasian nostrils.)

vibrissae constitutes an effective series of resistors or baffles to the air stream, slowing down the currents of air drawn into the nose, directing them upward into the external nasal pyramid for preliminary warming, and moistening them before their entrance into the nasal chambers proper.

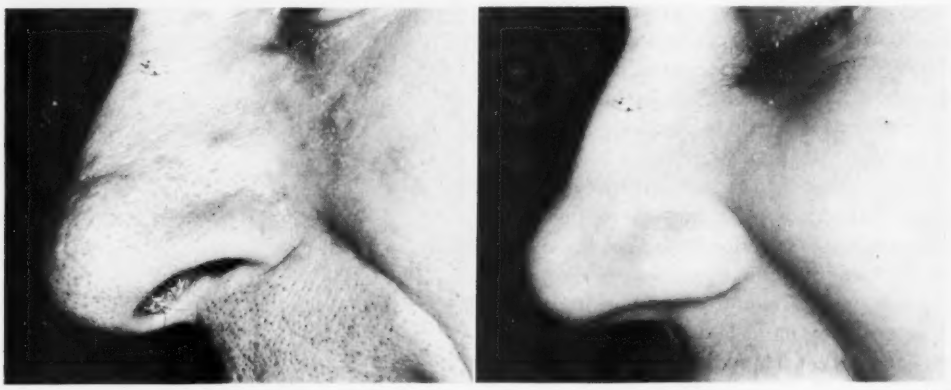
Between the lobular cartilage and the surface skin is a varying amount of subcutaneous tissues containing muscle fibers—the fibers of the muscles of expression. The skin of the lobule over the cartilages is not of uniform quality; it varies from thin to thick, from dry to oily, from pliable to stiff (Fig. 6).

The posterior portions of the lateral walls of the vestibule (the alae) do not contain any cartilage, the lobular cartilage going only about halfway back. Adipose fibrous tissue makes up their substance. Their posterior-inferior attachments may be to the face, lip, and columella and have been well described by Griesman.[2]

In order to see all the structures herein described, it is necessary to cut the vibrissae and examine the base of the nose without using a nasal speculum, and by utilizing good illumination and slight exposure movements with fine retracting instruments. Examining the vestibule with an electric otoscope is of great value. The obstructing hairs are held out of the way and with care distortion of the structures being examined can be avoided. The study of enlarged photographs, such as herein reproduced, is especially helpful in making a complete examination.

The shape of the nostrils, like all other parts of the nose, varies with the ethnic origin and the age of the person, and should be in anatomical harmony with the structures of the vestibule and the external nasal pyramid. In general, it may be said that Caucasian nostrils are almost vertical in their longest diameter (Fig. 5) when seen from below—the base view, whereas the true Negro nostril is horizontal or transverse (Fig. 7 *A*). Many other races, as for example the Filipino, strike a compromise between these two. The Caucasian nostril is more or less narrow and elliptical; the Negro's is wide and round. The former is associated with a high projecting narrow bony-cartilaginous pyramid, the latter with a flat, broad, low-lying nose. The Negro has less markedly developed baffles, and the floor of the pyriform aperture is not prominent, and

Fig. 6.—Differences in skin texture.



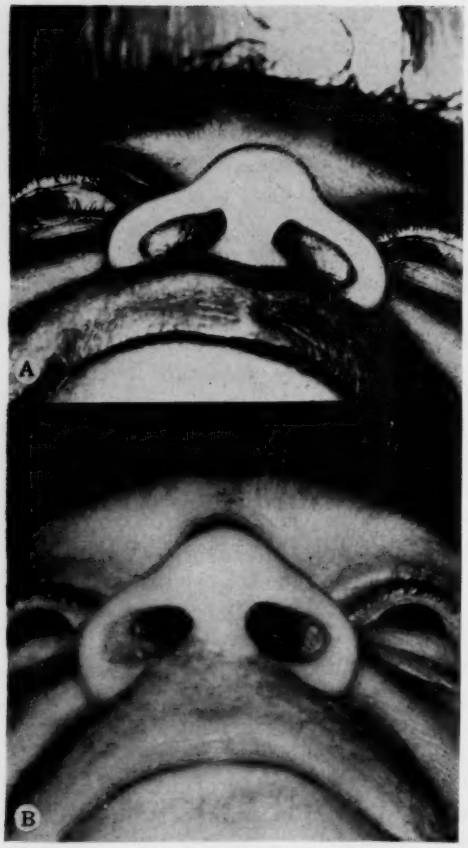


Fig. 7.—*A*, transverse nostrils of Negro are normal. *B*, transverse nostrils in white person are abnormal.

a true crest here is usually absent. Thus it does not offer obstacles to the passage of air from the posterior portion of the vestibule to the floor of the nasal chamber, as does the Caucasian nose. The very characteristic large, boggy, moist, inferior turbinates of the Negro nasal chambers can be seen by anterior rhinoscopy without recourse to a nasal speculum (Fig. 8*A*). A similar clinical picture in a white adult is distinctly abnormal (Fig. 8*B*).

Observation of the nasal profile reveals the angle that the inferior portion of the nose makes with the anterior surface of the upper lip. The length of the upper arm of the angle depends primarily on the length of its center structure, the columella, which, in turn, helps determine the shape and direction of the nostrils. The angle between the columella and the lip may be a right angle, an obtuse angle, or an acute angle, depending on whether the base of the nasal pyramid is in a horizontal plane, is inclined toward the base, or is turned upward. According to Topinard [1] and others, these are the three principal anthropological types of nasal profiles. When the nasal orifice position corresponds properly with the structure of the whole external nasal pyramid, respiration will be normal. When, however, pathologic causes produce a relative change in the position, size, and shape of the orifice out of harmony with its basic ethnic type of nose, functional difficulties will follow.

Deformities of the lobule, particularly overhanging or excessively long tips, or short and upturned noses, produce disturbances of nasal health and obstruction to breathing by

Fig. 8.—*A*, in Negro inferior turbinate is evident without use of speculum. (Note attachment of left alar foot. Inferior turbinate retouched in photograph.) *B*, in white adult easily seen inferior turbinate is not normal. (Turbinate retouched in photograph.)

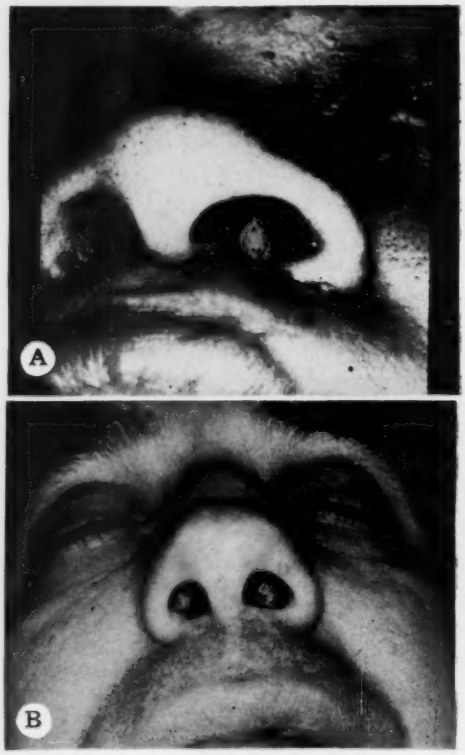


Fig. 9.—Premature newborn infant with typical normal base of nose.

misdirection of the air currents. It has frequently been noted that when the tip of the nose was elevated either temporarily by manipulation or permanently by surgical correction, the patient breathed better. Also, after fractures with drooping of the tip, raising the tip produced better nasal breathing. Patients who are dissatisfied with the adequacy of nasal respiration after submucous resection are often able to improve respiration by lifting the tip of the nose. As a result of these observations it may be concluded that the position of the lobular orifice in relationship to the rest of the nasal chamber is of prime importance for free respiration through the nose.

Children show progressive changes in the structural development of the vestibule. Usually a white child born by Cesarean section or prematurely has not suffered any compression of the nose and shows a vestibule structure remarkably similar to the adult Caucasian type (Fig. 9). In the usual normal labor, the cartilaginous vault, the lobule, and the vestibule are compressed, and thus distorted in the newborn (Fig. 10), but most frequently regain a normal appearance very quickly. When the flattened nose so produced persists, it superficially resembles the Negro nose, but even this usually changes markedly within the first year of life. The septal cartilage is often moved off the vomer or the maxillary spine, an injury which may be corrected with simple manipulation and with practically no trauma, but which on the other hand may leave a more or less permanent defect.

Fig. 10.—White newborn infant with moderate flattening of nose produced by normal labor.

Fig. 11.—White newborn infant. Nose pushed to right during prolonged labor.

More than 5% of children born after prolonged or difficult labor have the nose dislocated from the midline, as all nose injuries, including birth injuries, have downward force factors as well as lateral ones (Fig. 11). These injuries can also occur while the baby is still in the uterus and the baby may be born with a healed but deforming nasal fracture. The frequency of these nasal deformities can be understood when one realizes that the measurement of the child's head from the occiput to the tip of the nose is a long one. It is practically always as long as the measurement from the occiput to the chin, which is usually considered the longest head

diameter. In many normal newborn infants the measurement to the tip of the nose may even be as much as a centimeter more than to the chin.

Diagnosis of these newborn deformities can often be best made by inspection from below, and the base view of the nose of an infant can best be studied from enlarged photographs, preferably in color.

Prenatal nasal development can be evaluated by the shape and size of the nostrils, length and width of the columella, and the extent to which the feet of the ala seem to be joining the columella, as well as by the growth of the other structures of the vestibule.

Fig. 12.—White adult. Maxillary spine continuous with inferior edge of pyriform crest. Bone below is concave.

The posterior boundary of the vestibule, as already indicated, is the skin lying on the alveolar face of the superior maxilla. Superiorly this is bounded by the floor of the pyriform aperture, which is worthy of further consideration. In a normal white adult the bone here forms a definite sharp demarcating line. The bone immediately inferior to the edge is concave both in the horizontal and vertical meridians. Medially the spine is well developed and is a continuation of the floor edge; it projects anteriorly, and makes a substantial contribution to the structure of the nasal septum in this area (Fig. 12). The aperture floor at the entrance into the nasal chamber is concave, rather narrow, and leads abruptly downward on to the concave floor

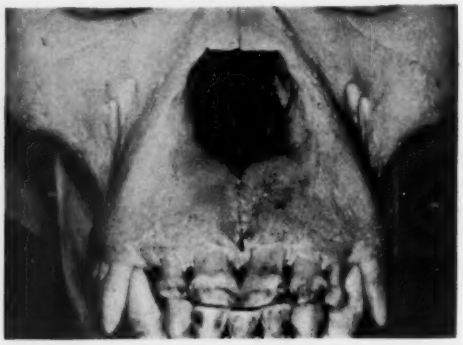


Fig. 13.—Gorilla. Pyriform aperture. No maxillary spine. No inferior crest. Floor of nasal chamber continuous with anterior surface of alveolar process.

of the nasal chamber proper. In a word, the floor of the pyriform aperture sharply separates the alveolar process from the nasal chamber. The floor of the nasal chamber is 5 to 8 mm. below the level of the aperture floor. In some skulls the sharp edge of the floor of the pyriform aperture is replaced by a plateau of bone measuring from 3 to 8 mm. in depth, and is referred to as the prenasal fossa. The floor of the nose behind it still lies at a lower level, as in other typical European-type skulls.

In the gorilla and chimpanzee the lateral portions of the pyriform aperture do not turn medially, but continue on laterally and downward, terminating in the cuspid tooth. The bone posterior to the edge of the aperture turns medially to meet its fellow from the

Fig. 14.—Negro pyriform aperture. Absence of inferior crest is normal. Bone of alveolar process continuous with floor of nose.

other side, thus forming a rounded, wide pathway from the anterior surface of the alveolar process on to the floor of the nose. There is no spine of the maxilla in the midline anteriorly (Fig. 13), and the surface is convex, as contradistinguished from the concavity of the white human. Occasionally in the latter this surface may be flat but not concave. It is interesting to note that though the Cro-Magnon man has some projection of the nasal bones he has no maxillary spine.

The pyriform crest in the typical adult Negro does not present a sharp edge on the floor separating the alveolar process from the nasal chamber, as described for the white adult. Instead the lateral portion of the aperture loses itself in the alveolar process, while the alveolar process medial to it rolls gently into a higher lying floor of the nasal chamber (Fig. 14). The floor of the aperture therefore is not sharply defined and lies below the floor of the nose. It does not flow onto and into the formation of the spine of the maxillary bone. In some instances the spine appears as if it were pasted onto the floor of the aperture as an afterthought rather than being an integral portion of the aperture floor formation. A dissection of a well-developed adult of American Indian origin showed a transition between the Negro and the white specimens. The floor of the aperture did not too obviously connect the lateral portion of the aperture with the maxillary spine, even though the latter was quite fully developed. The concavity of the floor edge was not too well marked and the bone beneath was not the double concavity described, but instead slightly convex. The floor of the nose was at about the level of the floor of the aperture, quite flat, not having the more marked concavity usually seen in the typical white adult. The same can be seen in a museum specimen identified as a prehistoric Indian (Fig. 15).

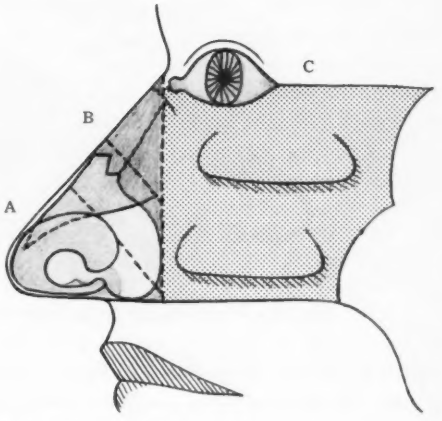
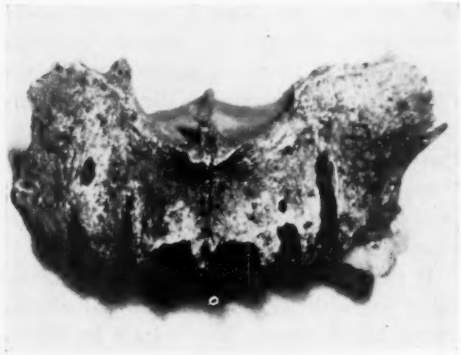


Fig. 16.—Physiological divisions of nose. Vestibule (*A*) and external pyramid (*B*) separated from internal nose (*C*) by nasal aperture running from internal canthus to alar facial groove.

Fig. 15.—Prehistoric Indian (courtesy Chicago Natural History Museum). Floor of nose at level of incompletely defined floor of pyriform aperture.



These anatomical considerations, together with other features of the rest of the pyriform aperture, are closely associated with other characteristic structures of the nasal lobule, notably the nostrils. The very flat nose of the primates would suggest that it is imperative that the alveolar process offers no resistance to the passage of air through the vestibules, but, on the contrary, makes it possible for the air to flow smoothly into the inferior portion of the nasal chamber. In the adult Negro the streams of air passing through the horizontally placed nostrils would be guided downward into the inferior portion of the nasal chamber, where they are received (in the flat nose) by the large, succulent, moist, inferior turbinates so well able to modify the temperature and humidity of very warm air. The nasal space anterior to the turbinates plays a lesser role in the Negro than in the typical adult white Nordic.

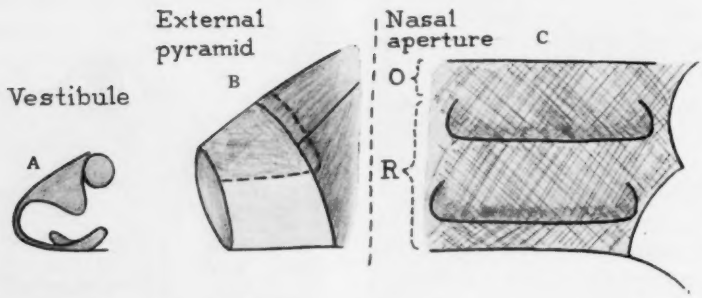


Fig 17.—Physiological divisions of nose. *O*, olfactory area; *R*, respiratory area.

In the latter the vestibule receives air which it helps shunt not into the inferior meatus and around the inferior turbinate but into the much larger external nasal pyramid and thence into the middle meatus and around the middle turbinate. Air in the posterior portion of the vestibule frequently encounters the barrier of the well-defined floor of the pyriform aperture and is thus thereby directed above the level of the inferior turbinate upward in the external nasal pyramid toward the middle turbinate. It is quite possible too that air also is guided into the cul-de-sac and from both of these areas whirled anteriorly into the ventricle of the vestibule, which is contained within the nasal tip, and thence through the valve into the nose. In many white people this seems to be extremely marked, so that the action of the alveolar concavity as a baffle to the air stream can hardly be questioned, and we have added it to the other baffles of the vestibule, which have been described as being of paramount importance in preparation of the air on inspiration. These other baffles, I might repeat here, are the following:

1. The free end of the medial crus of the lobular cartilage extending into its corresponding nostril.

2. The free end of the lateral crus of the same lobular cartilage protruding into the same nostril at a somewhat higher level.

3. The cul-de-sac formed by the upper lateral cartilage medially and the lateral crus of the lateral cartilage at a still higher level.

4. The upper lateral valve itself.

5. The floor of the pyriform aperture, therefore (in normal white adults), together with surrounding soft tissues about the vestibules and nostrils constitutes the fifth of the baffles, which, in my opinion, with the assistance of the vibrissae in the nostrils slow down the air currents, impart to them a little warmth, and direct them upward into the external nasal pyramid space (the nasal attic).

Many of the anatomical entities described are also important in creating resistance to the air currents on expiration as well as inspiration.

I have the feeling from the observations herein reported and other studies of nasal physiology that the white man's nose is a most efficient mechanism for making inspired air warmer, while the Negro nose probably has greater efficiency for making the inspired air cooler when necessary, though each type of nose can do both heating and cooling on demand. Each is probably more efficient for its individualized need. This thought is strengthened by consideration of white children's noses. Those that are flattened and have wide horizontal type nostrils seem to act more efficiently when the need is for the cooling of inspired air rather than for the warming of it.

The internal nose ends anteriorly at the level of the face. This is precisely where osteotomies through the superior maxillae are performed in rhinoplasties to move the external nasal pyramid, thereby actually creating a "nasal aperture" which normally exists only as the imaginary plane separating the external from the internal nose. It is to be distinguished from the pyriform aperture herein discussed.

It can be concluded that the vestibule of the nose, with its many anatomical components, helps prepare inspired air for its re-

ception by the external pyramid. The external pyramid in turn prepares the air for contact with the mucosa of the nasal chambers proper (the internal nose), while these in turn affect the modifications of the air currents prior to their passage into the lower respiratory tracts. The anatomical relationship of the vestibule to the rest of the nose is diagrammatically illustrated in Figures 16 and 17.

SUMMARY

The construction of the human nasal vestibule is reviewed. The characteristic ethnic differences are indicated as well as the differences in age groups. The ends of the lobular cartilages, the cul-de-sac, nasal valve, and floor of the pyriform crest are evaluated as functioning structures in the modification of air streams. Disharmony between the structures of the external nasal pyramid and the internal nose is suggested as a cause of nasal illness.

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Granulomatous Polyp of the Larynx Following Intratracheal Anesthesia

MERVIN C. MYERSON, M.D., Beverly Hills, Calif.

Granulomatous polyp of the larynx is an inflammatory tumor caused by trauma during endotracheal anesthesia. This condition was first reported by Clausen [22] in 1932. It occurs only in the adult larynx, may be unilateral or bilateral, is always due to trauma, and has a constant location on the laryngeal aspect of the vocal process of the arytenoid cartilage. In its early phase the polyp is always infected; hence histologically it is a pyogenic granuloma. At this time it measures between 5 and 9 mm. in diameter. Within a few weeks the epithelium of the adjacent structures gradually covers the polyp. As time passes the stroma of the tumor becomes fibrotic, new blood vessels form, and the original pyogenic granuloma is transformed into an angiofibroma. The pale-grayish polyp is now cherry-red or purplish-red according to the degree of vascularity present. As a result of these changes the tumor is much smaller than at the time of its first appearance.

The one constant prerequisite for the formation of a granulomatous polyp is that trauma must occur to the thin and exposed mucoperichondrium of the medial aspect of the vocal process of the arytenoid cartilage.

The employment of intubation of the larynx and trachea to maintain anesthesia and to prevent the entrance of blood into the air passages is not as recent as may be supposed. In 1858, Snow [1] administered chloroform to rabbits through a tracheotomy tube; 13 years later, Trendelenburg [2] used the same technique on a human being. It appears, however, that Macewen,[3] of Glasgow, Scotland, was the first to intubate the trachea perorally for anesthesia. In 1880, after some animal experimentation, he inserted a metal tube into the trachea under digital guidance. The laryngeal orifice was packed with gauze to prevent the passage of blood downward. To Elsberg [4] must be given credit for being the first to use the direct laryngoscope for introduction of the endotracheal tube. Before the time of Elsberg, these tubes were introduced with the aid of the fingers or with curved introducers. Prominent among the large number of workers who have contributed to the development of endotracheal anesthesia are Kuhn,* Meltzer and Auer,[8] Janeway,[9] and Rowbotham and Magill.[10] The technique and advantages of endotracheal anesthesia are well known. The disadvantages are not too frequently discussed, perhaps for good reason. These have to do with passage of the tube and the conditions which prevail after the tube is in place.

Analysis of the literature indicates that experience, skill, and judgment, all of which make for cautious and gentle manipulation, together with a regard for the patient's tissues are fundamental in the avoidance of trauma.[11] It has been shown that during passage of the direct laryngoscope the teeth, mouth, pharynx, and larynx are easily injured.[12] Employment of the intratracheal tube may be responsible for anything from slight edema to laceration of the pharynx, larynx, or trachea. The factors responsible for production of granulomatous polyps in adults are difficulty in passage of the tube, blind passage through the nose, improper

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* References 5 to 7.

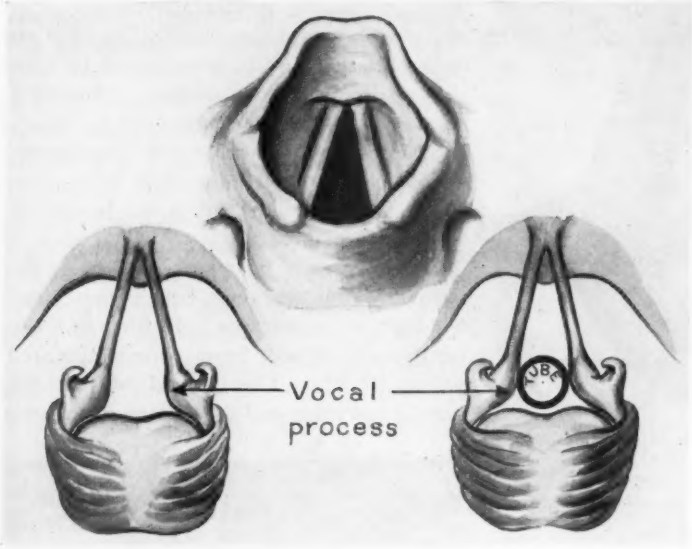

Fig. 1.—Semidiagrammatic, showing normal larynx and relation of vocal processes to interarytenoid region where endotracheal tube rests.

type of tube or oversized tube, motion of the tube during anesthesia, and lack of care when removing the tube.† In infants and children these same factors cause edema because of the greater resiliency of the laryngeal tissues.[17]

Some feel that blind passage of the tube through the nose is responsible in many cases. But the large number of cases of bilateral involvement which have been reported would indicate that the use of an oversized tube or the prolonged lodgment or undue motion of the tube must be considered. It is easy to understand how a tube placed posteriorly could cause trauma of varying degree in the presence of spasm or the normal closure of the larynx during the act of swallowing. It should be stressed, however, that the advantages of endotracheal anesthesia far outweigh its disadvantages.

I have been able to review all the articles which have appeared up to the present time on the subject of granulomatous polyps following intratracheal anesthesia.‡ As accurate a tabulation as is possible would place the total number of cases at 65; this does not include the 34 cases reported by 150 laryngologists to Flagg [47] in answer to a questionnaire. Of these, 14 were bilateral and 20 unilateral. In addition to this number I have seen 7 cases, making a total of 72 cases. Among these, 24 were bilateral, 28 were unilateral, and in 20 the location was not mentioned. There is a large number of unreported cases; many laryngologists have seen one or more and have not reported them. The ages of the persons affected range from 23 to 60 years, and more than 90% were females.

The type of operation does not seem to influence the incidence of this condition. The operations vary from the removal of a vocal cord tumor and tonsillectomy to gastrectomy and major thoracic surgery. Short operations should not be performed with use of intratracheal anesthesia because of the time required to obtain a successful depth of anesthesia for the proper passage of the tube.

The granulomatous polyp which follows intratracheal anesthesia is not the same as the granuloma which complicates the well-known contact ulcer. The latter occurs on the laryngeal aspect of the body of the arytenoid cartilage, while the granuloma which is a complication of endotracheal anesthesia is always situated on the same aspect of the vocal process. The attachment of the granulomatous polyp gradually

† References 13 to 16.

‡ References 18 to 47.

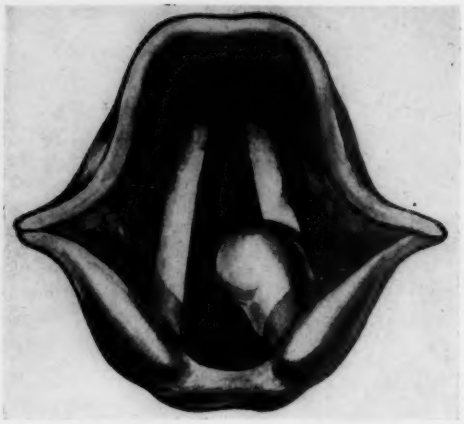

Fig. 2.—Mirror impression of larynx showing granulomatous polyp of left vocal cord.

changes from sessile to pedunculated, whereas the granuloma of the contact ulcer rarely is pedunculated. The granulomatous polyp always becomes epithelized and does not occur if removal is performed after epithelization is complete. The contact ulcer granuloma usually recurs when removed; it is for this reason that many laryngologists are not in favor of removal of the contact ulcer granuloma but await spontaneous healing.

The histopathology of the new-formed granulomatous polyp is the same for all cases. It presents the picture of a healing inflammatory granulomatous process. The sections display many neutrophiles, eosinophiles, some lymphocytes and plasma cells, and new-formed blood vessels, in addition to fibroblasts. After six or more months have elapsed the microscopic picture is that of a fibroangioma. Then one encounters an abundance of fibrous connective tissue and new-formed blood vessels in addition to lymphocytes, plasma cells, and some hyalinized collagen formation.

Some degree of hoarseness is present immediately after operation, but the polyp may not make its appearance until three or more weeks have elapsed. In one case it appeared within 10 days. The interval between the time of operation and the time of appearance of the polyp would seem to vary with the intensity of the trauma. Because a long period of time, even months, may elapse before an involved larynx is examined by a laryngologist, one may get the erroneous impression that the polyp was in process of formation for such a period of time. In addition to hoarseness, a sensation of fulness usually is present. Bilateral polyps when large enough may cause asthmatoid breathing, stridor, and even obstructive laryngeal dyspnea, requiring tracheotomy. Tracheotomy was necessary in two of the reported cases. As the polyp becomes epithelized and pedunculated, not only does it become

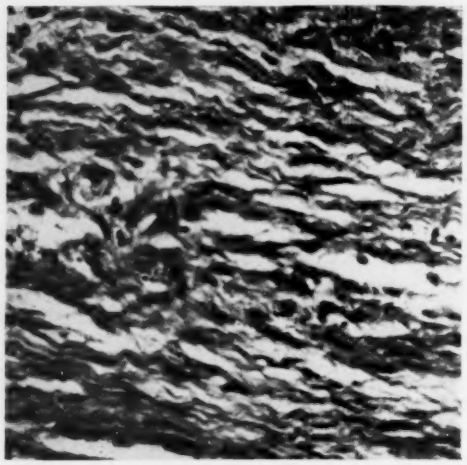

Fig. 4.—Photomicrograph of cross section of granulomatous polyp showing the presence of neutrophiles, plasma cells, and lymphoid cells; reduced ½ from mag. × 900.

Fig. 3.—Mirror impression of larynx showing granulomatous polyp of each vocal cord.

smaller and firmer but it is more movable, making the person more aware of its presence. This mobility is responsible for cough, which may cause rupture of superficial blood vessels and blood-streaked sputum. In two of the reported cases the pedicle of the tumor became so narrowed that the tumor was coughed up.§ In another case the polyp regressed spontaneously.[22]

The treatment is prophylactic and surgical. Attention to details of technique so as to eliminate or avoid trauma to the larynx is important. Once the tumor mass is evident, there are two alternatives. One can either combat infection and hope for resolution of the granuloma or remove the polyp after epithelization and pedunculation are established. The nonsurgical treatment consists of complete vocal rest and the use of an antibiotic, such as oxytetracycline hydrochloride (Terramycin) or tetracycline hydrochloride (Panmycin) in aerosol form. If seen early enough this treatment may favor regression of the granuloma and complete healing. If the granuloma is removed before epithelization, there is a good chance that it will recur. Once the polyp is epithelized, only removal by direct or indirect laryngoscopy will suffice. Before removal, the larynx should be placed at complete rest for at least 48 hours to allow the inflammatory reaction which is usually present to subside. Because of the posterior position of the tumor, indirect laryngoscopic removal is preferred. The patient is spared the discomfort and manipulation which go with direct laryngoscopy. Removal can be performed quickly under local anesthesia with the patient sitting comfortably in a chair and hardly aware of the manipulation.

Fig. 5.—Bilateral granulomatous polyps, eight months' duration. Note shrinkage in size and pedunculation.

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Mobilization of Middle-Ear Structures Through the Eustachian Tube

SYLVESTER DALY, M.D.
LOUIS J. GOLDSTEIN, M.D.
MORRIS HELLER, M.D.
BERNARD ANDERMAN, M.A.
and
MARGARET MOLLE EZEKIEL, M.A., New York

A history of otolaryngology credits Antoine Saissy (1754-1822), a French surgeon of Paris, as being the first physician to use Eustachian-tube bougies. Some years earlier, in 1724, Edme-Gilles Guyot, a French postmaster at Versailles, reported to the Academie Royale des Sciences his method of relieving his own deafness by the use of a curved tube passed into the mouth and behind the palate. Guyot was not a physician, and his contribution—the first Eustachian catheter—excited little comment. The anatomists of his day would not admit that it was possible to syringe out the Eustachian tube by way of the mouth.

The technique of Eustachian-tube treatment of catarrhal and suppurative otitis media, and its associated deafness, was first most completely reported in American medical literature by Yankauer in 1910. Yankauer's methods were fairly widely accepted and practiced by his contemporaries. With the advent of the antibiotic era, however, Eustachian tubal methods of treatment were relegated to the background. They were considered somewhat outmoded, along with the use of mild silver protein (Argyrol)—a drug prominently featured in Yankauer's treatments. Politzer's air inflation of the tubes is all that remains today of this former elaborate procedure.

Scattered through the literature of otolaryngology, written by those physicians impressed with the true value of this form of therapy, occasional references to Eustachian tubal methods of treatment are found. For some unaccountable reason this technique has not gained widespread use. In the textbook "Diseases of the Ear, Nose and Throat," by Jackson and Jackson, there is illustrated the Coates special heating apparatus for insufflation of medicated vapors through the Eustachian catheter into the auditory tube. This same text also makes mention of Simon's heated bougie. Miller, in 1931, writing of his own experience with Eustachian-tube treatments, praised the Yankauer methods and stated that objections to the procedure arose from inexperience or faulty technique. E. P. Fowler Jr., in an

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D-OL, Chief of ENT and Audiology, a part-time V. A. physician, Attending Otolaryngologist to Presbyterian Hospital and Vanderbilt Clinic, Columbia-Presbyterian Medical Center (Dr. Daly). D-OL, a full-time career otolaryngologist to the V. A. (Dr. Goldstein). D-OL, a part-time V. A. physician, Associate Attending Otolaryngologist to Manhattan Eye and Ear Hospital, Acting Associate Attending Otolaryngologist to Mount Sinai Hospital, and Consultant in hearing and speech to the New York State Rehabilitation Hospital (Dr. Heller). Chief of Clinical Acoustics, ENT-Audiology Clinic, N. Y. R. O. V. A. (Mr. Anderman). Chief of Speech Correction and Auditory Rehabilitation, ENT-Audiology Clinic, N. Y. R. O. V. A. (Mrs. Ezekiel).

article written in 1945, explained the relation of the physical state of the Eustachian tube and both its orifices to the production of deafness in aviators. This paper gives many references which deal with the clinical anatomy of the tuba auditiva and with its importance in otic barotrauma and in aerootitis. A previous communication by this same author describes his technique in using radon to clear lymphoid hyperplasia from around the pharyngeal orifice of the Eustachian tube. Two Italian investigators, Bazzana and Lombardo, in 1950 described their experiences with aerosol therapy of the Eustachian tube and tympanic membrane.

Yankauer made abundantly clear that dilation, bougienage, and opening of obstructed Eustachian tubes were of great benefit to hearing in certain cases. The entry of air into a previously blocked middle ear, with reestablishment of equality of pressure on each side of the membrana tympani, meant also some restoration of normal physiology and many times restoration of function. However, physical contact of the bougie with middle-ear structures themselves was not the main purpose—a fact quite readily realized when the original articles are read.

The Yankauer twisted wire Eustachian applicator and Eustachian bougies were designed primarily to extend the length of the Eustachian tube and no further. To prevent the tip of the bougie from inadvertently entering into or impinging upon middle-ear structures, colored bands were painted around the shank of the instrument at various intervals along its length to mark its passage through the Eustachian tube and to control its advance to a point just beyond the isthmus.

The concept of deliberate short-circuiting of middle-ear structures by labyrinthine fenestration to improve hearing was gradually developed by the pioneer investigations of Bárány, Holmgren, and Sourdille and later extended and perfected by Lempert and his pupils. Recently Rosen has revived manipulation of middle-ear structures following the earlier work of a French author, C. Miot. The extensive and exhaustive investigations of hearing, as described in the book by Stevens and Davis and more recently in the book by Wever and Lawrence, have popularized the theories of the hydrodynamics of the cochlea and of the transformer action of the ossicular chain of the middle ear. These various theories of hearing are now fairly generally known and discussed.

In an effort to improve the hearing of the many veteran patients seen in this clinic suffering from long-standing deafness and middle-ear disease, one of us (S. D.) conceived the idea of attempting to mobilize the middle-ear structures via the Eustachian tube with Eustachian bougies.

METHOD

No highly selective procedure was followed in choosing patients for study. Cases of long-standing purulent otitis media were studied as were those with dry ears and intact drum membranes. Most of these patients had been wearing a hearing aid for several years. All patients had an audiogram prior to treatment. Not all of the cases reported were veterans; also included were some patients from private practice (S. D).

TECHNIQUE

As a preliminary step, the patient was given 1.0 grain (60 mg.) of phenobarbital by mouth and the procedure explained. The patient's nose was initially sprayed with 2% aqueous cocaine hydrochloride. Following this a few drops of 10% cocaine and epinephrine (1:1000) were placed on cotton wound on the ends of Brown's nasal applicators. The applicators were bent so that when introduced through each nostril and twisted laterally the cotton and medication were in close proximity to the nasopharyngeal orifice of each auditory tube. The applicators were left in situ for about five minutes, and then the nose was irrigated with warm sterile saline solution in order to remove any thick mucus from the nasopharynx.

A metal Eustachian catheter was then introduced through the nostril on the side of the ear selected for treatment. A nasopharyngoscope was then passed through the

opposite nostril and under nasopharyngoscopic vision the catheter was rotated so that its end fitted snugly into the mouth of the auditory tube. Some of the cases had varying degrees of septal deviation. These presented problems of dexterity in passing the catheter through curved and partially obstructed nasal passages. Sometimes it was necessary to reshape the curve of the metal catheter by finger manipulation. At this point it was made certain by trial tests that the reshaped metal catheter offered no obstruction to the passage of bougies through the lumen before the catheter was reintroduced into the nose. The nasopharyngoscope was then withdrawn and the catheter held gently but firmly in place with one hand.

Fig. 1.—Nebulizing mist spray used through the Eustachian catheter.

An important step in the technique and one considered by us quite vital to success was now carried out. This was to use the nebulizing mist spray through the Eustachian catheter while the latter was engaged in the mouth of the auditory tube. (See Figure 1.) This procedure carries a fine decongestive mist throughout the length of the tube, shrinks the lining mucosa of the tube, and prepares the lumen for the subsequent passage of the bougie. We feel that this procedure is superior to the older methods of using the Yankauer twisted wire applicator with the tip wound with cotton, since nothing touches the mucosa of the lumen of the Eustachian tube except the liquid mist particles of the aerosol.

The solution used for the mist spray was 0.25% phenylephrine (Neo-Synephrine) containing, dissolved within it, one tablet of water-soluble penicillin of 100,000 unit strength. Total volume in the nebulizer bottle was about 25 cc. Where it was determined that a particular patient was allergic to penicillin, one tablet of tetracycline (Achromycin), 50 mg., water-soluble, was used in place of the penicillin. Polymyxin B sulfate, 6000 units in 15 cc. of methoxamine (Vasoxyl), was frequently used; also hydrocortisone acetate and neomycin sulfate (Neo-Cortef), 1.5%, was commonly used as a second mist spray following the phenylephrine. If a general allergy to various antibiotics was known or suspected, 0.5% phenylephrine alone was used.

The ordinary pressure used for routine nasal spraying was employed for carrying the mist from the nebulizer bottle through the metal catheter into the Eustachian tube. When this mist spray emerging from the curved end of the metal catheter was tested against a column of mercury in a standard blood pressure apparatus, it was found that this pressure was equivalent to approximately 150 mm. of mercury, or between 15 and 18 on the dial of a pressure gauge mounted on the electric spray pump.

With the Eustachian catheter in place in the nose and with its distal curved end snugly in place in the mouth of the Eustachian tube, a bougie of narrow cross section diameter was then placed in the mouth of the lumen of the catheter and cautiously moved along until the isthmus of the auditory tube was reached. At the isthmus, even in those auditory tubes widely patent, there was usually felt some slight degree of block. This is easily overcome, and continued pressure on the bougie will carry its distal end on through to the opening into the middle ear. If the tube was patent a bougie of slightly larger and stiffer caliber was passed, the more rigid bougie permitting some degree of pressure to be brought to bear upon the drum membrane and ossicles. In its final position the end of the bougie was held between the thumb and index fingers and very gently

and carefully moved in and out, so that some degree of motion was imparted to those middle-ear structures in contact with the distal end of the bougie. If real obstruction was met, the proximal end of the bougie, held between the thumb and index fingers, was rotated clockwise, giving a circular twist to the distal end in the auditory tube. By means of this circular twist, it was frequently possible to "snake through" a narrowed passage or incomplete obstruction. It was often found advantageous here to pull the bougie back and completely out of the catheter and, at this point, use the nebulizing spray once again. Bougies of various thicknesses and of varying lengths were now tried. A dozen or more bougies

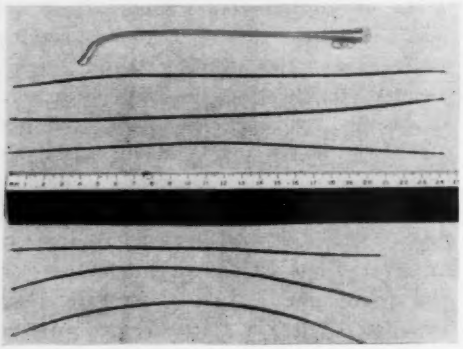

Fig. 2.—Bougies of various thicknesses and of varying lengths.

of various types were spread out on a sterile towel, enabling the operator to make a quick selection of the instrument considered most appropriate. (Figure 2 shows some of these.)

Whenever possible two physicians worked as a team. The second physician examined the ear with an otoscope, placed in the external auditory canal, while the first physician carefully manipulated the bougie. In those patients in whom the drum membrane was not too thick or opaque, it was quite possible to see the dark tip of the bougie through the drum, observe its particular position within the cavity of the middle ear, and, finally, to determine if any motions of the drum membrane were produced as the bougie tip was brought to bear upon the inner surface of the membrana tympani or upon the ossicular chain.

Positive motion of the membrana tympani, as observed through the otoscope, is not to be taken as final evidence of success in improving the hearing. Several cases were seen in which some motion of the drum membrane and handle of the malleus were noted, but audiograms taken immediately after the treatment showed no gain in hearing. In the book "Physiological Acoustics," by Wever and Lawrence, mentioned previously, the chapter on the transformer action of the ossicular chain provides information which may explain, in some degree, the above phenomenon.

As described in this reference, the joint between the incus and stapes is of such a nature that some motion of the incus is possible without causing the stapes to follow. Also, the incus itself has a moderate degree of independent motion so that it does not follow the malleus completely but lags a little during both the inward and the outward phase of vibrations. Thus it is possible to effect motion of the drum membrane and of the malleus by the bougie tip without necessarily increasing the mobility of the stapes. It is hardly necessary to mention that if the pathology of the deafness is truly located within the cochlea, any manipulation of the conduction system of the ear will show no improvement in the audiogram.

In about 1% of the cases studied such complete obstruction was present that the bougie could not be passed into the middle ear. This obstruction is not always due to stenosis. The normal S-shape of the Eustachian tube may be very exaggerated in certain patients so as to point the distal tip of the bougie against the roof and thus prevent its proper progress. Obstruction can also be caused by pockets in the lining tissues. In the previously mentioned articles by E. P. Fowler Jr. dealing with causes of deafness in flyers, these pockets are very completely described and photographs of them are shown.

There were also cases that required at least three treatments (usually at weekly intervals)

before complete passage of the bougie into the middle ear was successfully accomplished. Two cases of long-standing clinical otosclerosis were also investigated. In both of these the bougies were fairly easily passed into the middle ears and motion of the bougie tips observed through the otoscope. Repeated manipulations failed to produce any visible motion of the drum, indicating presumptive fixation and immobility of the middle-ear structures. Not all of these cases are reported upon in this paper.

No effort will be made in this communication to attempt any exact explanation of the mechanism of the bougie pressure on middle-ear structures.

In most cases where there was no obvious scarring and adhesions within the middle ear, otoscopic examination seemed to show that the bougie tip travelled fairly high up and in the vicinity of the incudostapedial joint. In other cases, where disease had produced adhesive changes in the normal anatomy, the bougie tip progressed in a serpentine fashion and in a most random manner. In some cases it bent laterally and impinged upon the drum so as to produce pressure outwardly. In certain other cases it pointed over the ossicular chain in the area of Schrapnell's membrane. In this location manipulation produced downward pressure on the ossicular chain. The impression is strong that the general effect is one of mobility of the whole structure, drum membrane, and entire chain of ossicles rather than selective action upon one individual ossicle. We feel that the entire procedure is not unlike that of massage to a stiffened joint.

It may be said here that no unusual reactions were encountered at any time. There was no unusual amount of after-pain, and in only one case, where many middle-ear adhesions were present, did any of the patients complain of any serious discomfort. This was controlled by oral administration of 1 grain (60 mg.) of codeine.

Every patient treated was willing, and in most cases eager, to undergo repetition of the treatment. All were united in saying that repeated treatments were easier to experience and were associated with less discomfort. Not a single case was attended by any hemorrhage within the middle ear, nor did any cases of otitis media develop as a result of bougienage of the middle ear.

A word regarding sterilization of the bougies is in order here. It was found that the most satisfactory sterilizing medium in which to immerse the bougies was aqueous benzalkonium (Zephiran), 1:1000 dilution. When the bougies were placed in sterilizing media such as potassium mercuric iodide (aqueous 1:5000) or mercuric chloride (bichloride of mercury), the metallic salts of the solution seemed to react chemically with gum elastic coating of the bougie, so that the surface of the instrument became rough and sticky. The usual procedure was to place the bougies in a flat pan with sufficient benzalkonium to cover them completely. They were left in contact with the antiseptic solution for a period of one hour. After removal from the benzalkonium the bougies were thoroughly rinsed with sterile isotonic sodium chloride solution. Any droplets of saline solution adherent to the surface of the bougie were blown off by a stream of air from the suction-pressure pump. They were then spread on a sterile towel and were ready for use.

Repeated passage of the bougies through the metal catheter will often result in stripping and furring of the linear surface of the silk and gum elastic coating of the instruments. These partially detached strands are very fine and hair-like in consistency. To avoid any possible trauma to the lining of the tuba auditiva, all bougies should be individually inspected before use. This inspection should include the use of a magnifying glass. Those bougies showing any defects should be immediately discarded. The surface of the lumen of the metal catheter should be smooth, as any rough spots or irregularities will quickly ruin a set of bougies. Figure 2 shows some special nylon custom-made bougies, which are very durable and useful.

REPORT OF CASES

CASE 1.—A World War I veteran with bilateral purulent otitis media since 1919. More or less constant drainage from both ears since onset. For irregular periods of a few months in warm weather ears might remain dry. Large central drum perforations, both ears. Some granulation tissue and pus in both middle-ear cavities. Serious loss of hearing in both ears. This patient wore a hearing aid in right ear since 1949.

Culture of pus from ears showed the infecting organism to be hemolytic Staphylococcus aureus (coagulase positive). Sensitivity tests showed this Staphylococcus strain to be sensitive to chlortetracycline (Aureomycin), chloramphenicol (Chloromycetin), and streptomycin and to be resistant to all other antibiotics. Cauterization of the granulation tissue was done with 75% silver nitrate solution. Internal and local ear treatment with chlortetracycline gave some improvement in the amount of purulent discharge from the ears. Repeated air inflations of the Eustachian tubes gave no appreciable improvement in hearing.

A series of five bougienage manipulation treatments to the middle-ear structures at weekly intervals resulted in the improved hearing in both ears, as shown in Figures 3 and 4. Inability to improve the hearing in the low-tone range is due, in some degree at least, to the presence of the large central drum perforations and to the necrosis of part of the ossicular chain as a consequence of the long-standing purulent otitis media. Improved hearing has persisted for three months. Both middle-ear cavities are now dry. (Figures 3 and 4, Case 1.)

CASE 2.—This patient was not a veteran but was a private patient of one of us (S. D.). P. K., a 54-year-old man, with ear difficulties for many years. Originally had bilateral purulent otitis media in childhood. Slowly progressive deafness in right ear for three years. Right ear drum intact but very thickened and opaque. Chronic purulent otitis media of left ear, with central drum perforation and pus. Small amount of granulation tissue in the middle-ear cavity of the left ear. Persistent drainage from left ear despite one year's treatment by a very capable otolaryngologist. These treatments included air

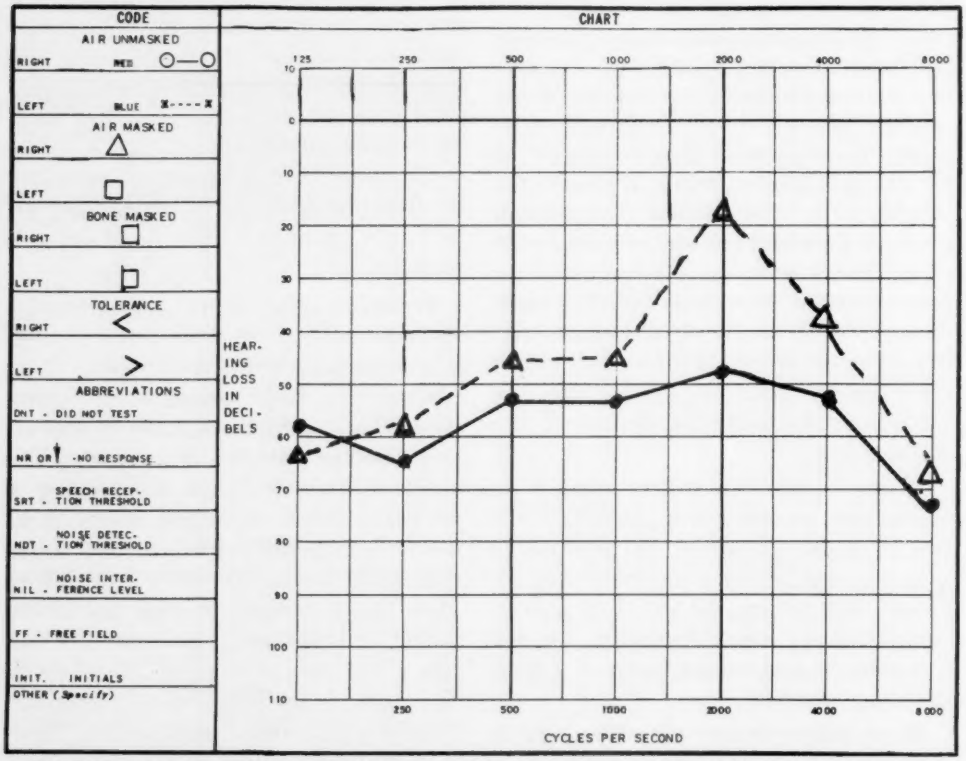

Fig. 3 (Case 1).—The solid line indicates air-conduction audiogram of the right ear prior to treatment. The broken line represents the same ear three months after treatment. Speech reception threshold not determined before treatment; 50 db. at time of above test.

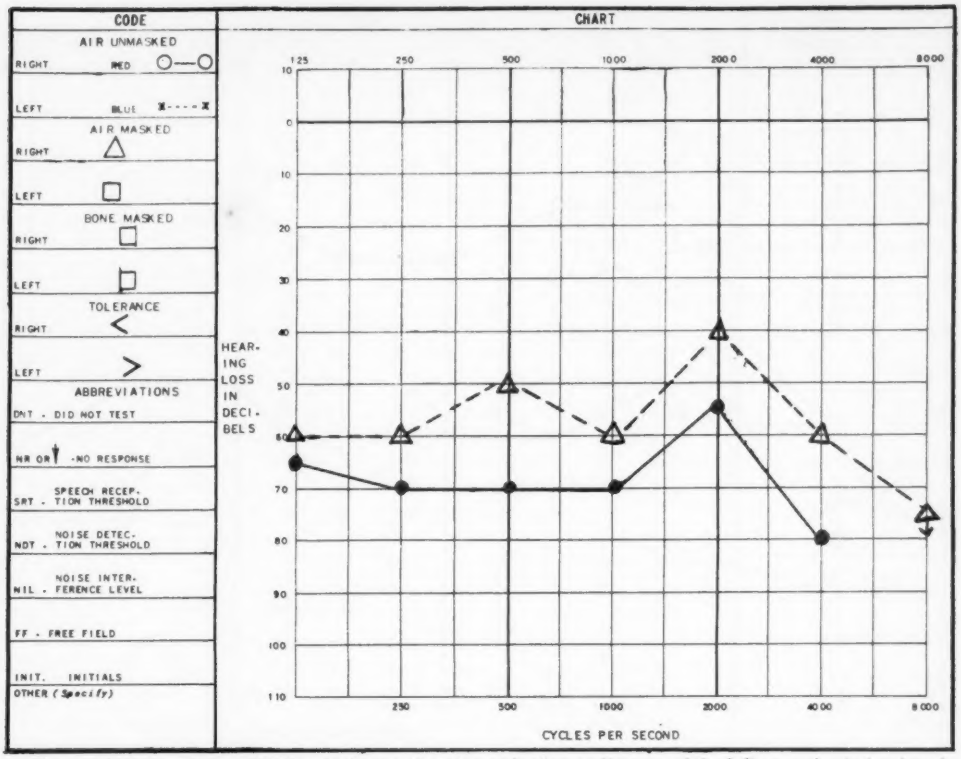

Fig. 4 (Case 1).—The solid line indicates the air-conduction audiogram of the left ear prior to treatment. The broken line represents the same ear three months after treatment. Speech reception threshold not determined before treatment; 50 db. at time of above test.

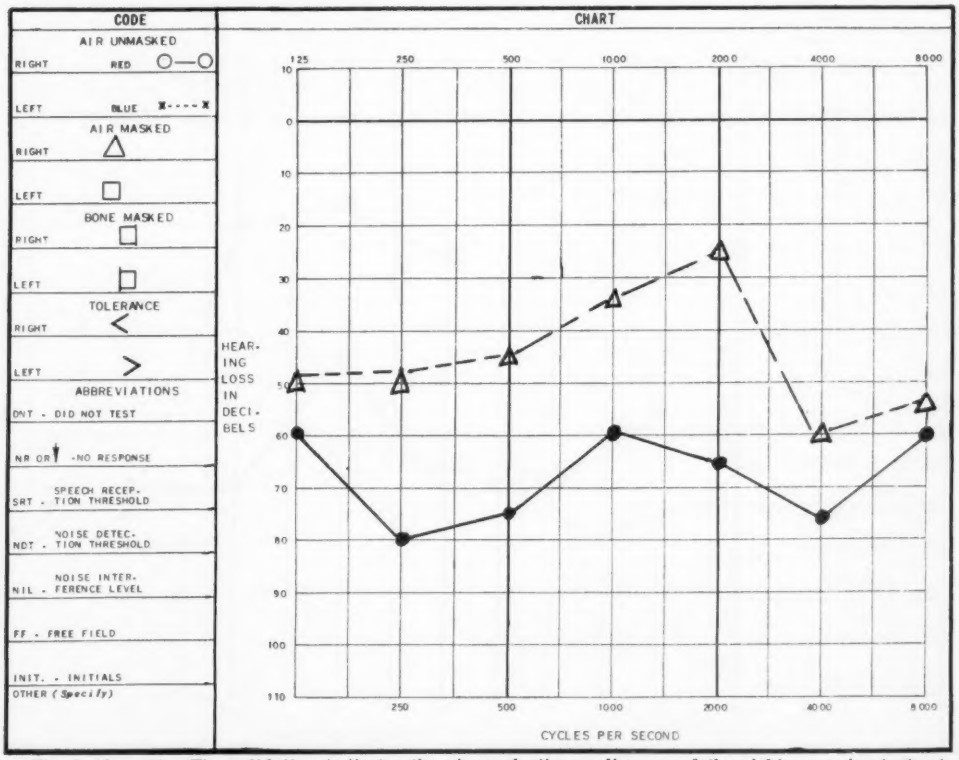

Fig. 5 (Case 2).—The solid line indicates the air-conduction audiogram of the right ear prior to treatment. The broken line represents the same ear three weeks after treatment. Speech reception threshold not determined before treatment; 42 db. at time of above test.

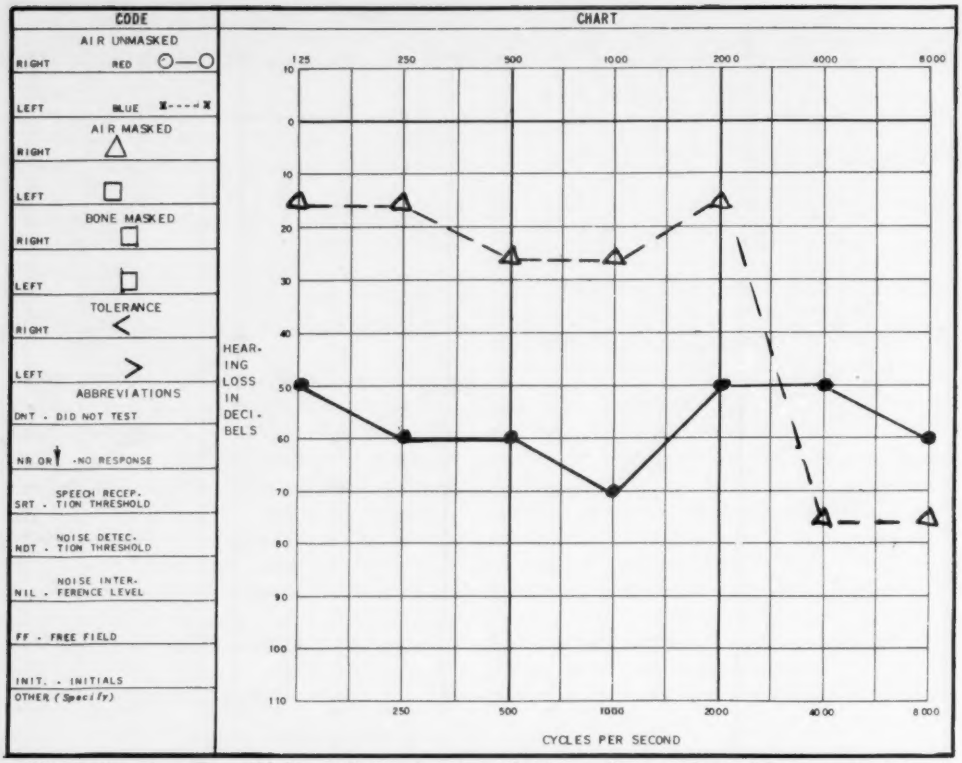

Fig. 6 (Case 3).—The solid line indicates the air-conduction audiogram of the right ear prior to treatment. The broken line represents the same ear three weeks after treatment. Speech reception thresholds not determined before treatment; 30 db. at time of above test.

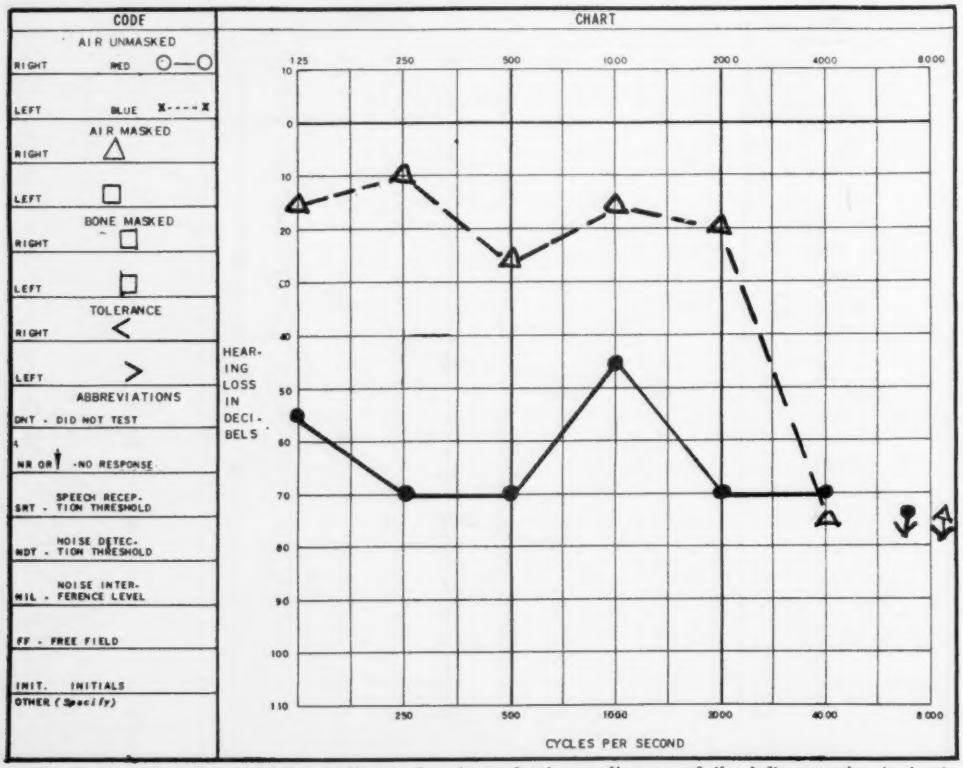

Fig. 7 (Case 3).—The solid line indicates the air-conduction audiogram of the left ear prior to treatment. The broken line represents the same ear three weeks after treatment. Speech reception threshold not determined before treatment; 27 db. at time of above test.

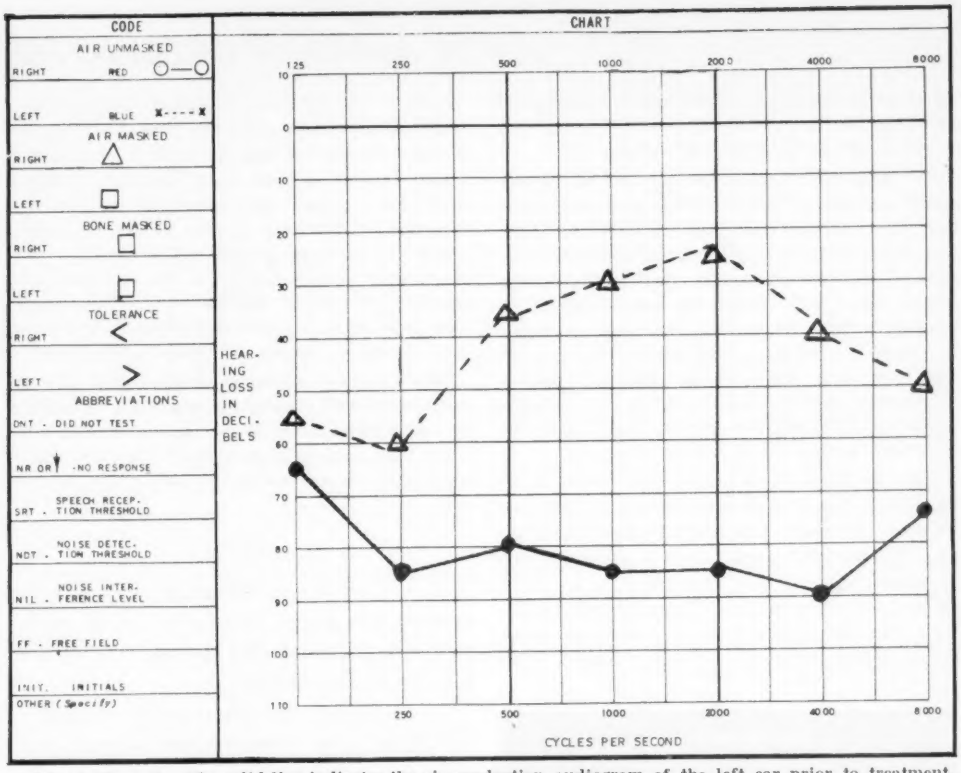

Fig. 8 (Case 4).—The solid line indicates the air-conduction audiogram of the left ear prior to treatment. The broken line represents the same ear 10 days after treatment. Speech reception tests were not done.

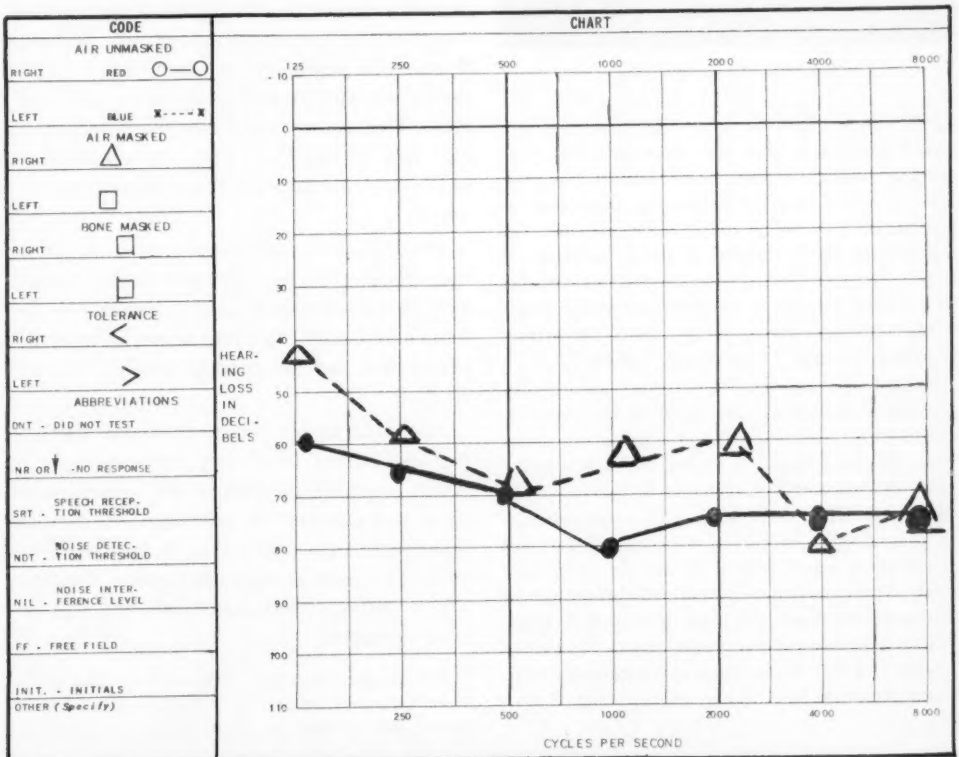

Fig. 9 (Case 5).—The solid line indicates the air-conduction audiogram of the right ear prior to treatment. The broken line represents the same ear two months after treatment. Speech reception threshold not determined before treatment; 68 db. at time of above test.

inflations of both Eustachian tubes. Audiogram showed severe loss of hearing in the right ear and almost total loss of hearing in the left ear.

The granulation tissue in the left middle-ear cavity was destroyed with 75% silver nitrate solution. This patient was given a series of three bougienage treatments to each ear at intervals of one and later two weeks. After these treatments the left ear ceased draining and has remained dry. The hearing in the right ear was improved, as shown in Figure 5. Thickness and opacity of the drum membrane in the right ear permitted only shadow visualization of the bougie tip in this ear. Duration of improved hearing two months (up to the time of present writing) (Fig. 5, Case 2).

CASE 3.—C. E. T., a private case of one of us (S. D.). A man aged 34 with deafness for one year following an attack of double otitis media one year ago. Tinnitus both ears, worse in the right ear. Treatment by several otolaryngologists for eight months, including bilateral Eustachian-tube inflations, with no real improvement. Both drum membranes intact but thickened and retracted. This

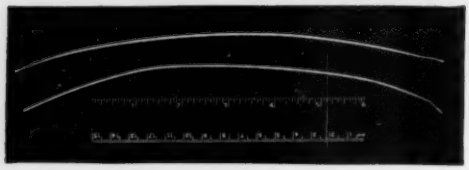

Fig. 10.—Nylon bougies.

patient's audiogram was very suggestive of a true mixed deafness in that the high-tone range consistently showed lowered bone-conducted hearing. He was given bilateral bougienage treatments on four separate occasions at two-week intervals. The improvement in his hearing is shown in Figures 6 and 7. Duration of improvement two months (up to the time of present writing). According to patient's statement, the annoyance from the tinnitus is greatly lessened (Figs. 6 and 7, Case 3).

CASE 4.—A man aged 64, a private patient complaining of feeling of obstruction in left ear associated with severe ringing and buzzing sensations. Both ear drum membranes were intact. His audiogram showed a very severe loss of hearing by air conduction. There was fairly good preservation of bone conduction except at 4096 and 8192 cycles, where there was a loss of 45 and 55 db., respectively. The improvement in hearing in his left ear for air-conducted sounds is shown in Figure 8. Duration of improvement five weeks (up to the time of present writing). He received two bougienage treatments separated by a 10-day interval (Fig. 8, Case 4).

CASE 5.—A. Z., a veteran aged 36, deaf since 1942, after exposure to rifle fire. Denied any history of otitis media. No family history of deafness. Severe tinnitus in both ears. Hearing aid worn since 1945. Drum membranes intact, slightly thickened and retracted. Despite history of possible trauma to auditory nerves and because of fair preservation of bone conduction this case was considered to be one of otosclerosis. Ten bougienage treatments, at weekly intervals, resulted in a slight improvement in hearing, as shown in Figure 9.

This case was presented to show that even in cases of chronic otosclerosis where some mobility of conduction persists slight improvement is possible. This improvement, though admittedly very small, may increase the effectiveness of the hearing aid (Fig. 9, Case 5).

SUMMARY

A method for mobilization of middle-ear structures is given. This method is an extension of a technique long practiced in the history of otolaryngology.

Early studies indicate that this method is of definite value in treatment of cases of deafness associated with chronic purulent otitis media. The method can be used with benefit whether the ear is still suppurating or whether the ear has dried up and deafness remains as permanent residual, due to scars, adhesions, and fixation of the drum and ossicles. This is important because deafness of this type is rarely, if ever, considered suitable for fenestration or for stapes mobilization.

Preliminary investigations seem to show that this method has apparent limited benefit even in long-standing cases of clinical otosclerosis where slight mobility of the drum membrane and ossicles persists and can be activated.

It should be obvious to everyone that the method cannot be of any help in cases in which complete fixation of the stapes exists as a consequence of advanced otosclerotic bone pathology. Likewise, it can be of no value in cases of true perception deafness where intracochlear structures are irreversibly damaged.

The bougies shown in Figure 2 are procurable from George Tiemann & Sons, Surgical Instruments, 107 E. 28th St., New York.

A set of nylon bougies were specially made for us by M. Clifford Zabriskie, of 246 N. Main St., Pearl River, N. Y. Two of these nylon bougies are shown in Figure 10.

252 Seventh Ave.

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A Radium Applicator for Treating Carcinoma of the Nasopharynx

MARTIN VAN HERIK, M.D.
and
JOHN B. ERICH, M.D., Rochester, Minn.

Most carcinomas in the nasopharynx are highly malignant tumors, which because of their location and activity are preferably treated by irradiation rather than by surgical means. In the treatment of lymphosarcoma and lymphoepithelioma, external radiation alone is usually the method of choice. Squamous-cell carcinoma, however, is more radioresistant, and experience has shown that intracavitary radium therapy combined with external roentgen radiation may offer a better prognosis than external radiation alone, particularly if the lesion is localized. On the other hand, very high energy radiation (radioactive cobalt or 2,000,000-volt x-rays) can be administered safely by external means alone, in doses equal to those attainable by combined intracavitary radium and moderate-voltage external roentgen therapy. If this high energy radiation is employed, there usually is no need for supplementary intracavitary radium therapy; however, since high energy equipment is not universally available, intracavitary radium therapy remains a valuable adjunct to the treatment of certain squamous-cell carcinomas of the nasopharynx.

Many types of applicators have been devised in an effort to overcome the technical difficulties of employing radium within the nasopharynx while at the same time giving fairly even dosage throughout the lesion without excessive radiation damage to normal structures. Most radium applicators are either mounted on some form of metal handle, often of pliable lead, or have the radium tubes contained in a rubber catheter. These applicators are introduced into the nasopharynx through the mouth or through the nasal cavity. Unfortunately, many of them do not always irradiate the entire lesion adequately or, in doing so, overirradiate normal tissue. In addition, they are often troublesome to maneuver or to maintain in proper position, and some of them cause severe discomfort or retching.

DESIGN OF APPLICATOR

We have devised an applicator that seems to have overcome most of these disadvantages (Fig. 1). It consists of a plaque of Bakelite with rounded edges, measuring 2.0 by 2.25 by 0.7 cm. Three holes are bored in it longitudinally to hold the radium tubes. Although the holes extend through the entire length of the applicator, the diameters at one end are smaller to prevent the tubes from slipping out of the applicator at that end. The tubes are threaded with linen strings that are inserted through the applicator from the bottom and emerge at the top, where the holes are of smaller bore, except that one end of the loop threaded through the center tube is held back so that it emerges from

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Marvin M. D. Williams, Ph.D., of the Section of Biophysics, participated in the design of the radium applicator and prepared the dosage data.

From Section of Therapeutic Radiology (Dr. Van Herik) and Section of Plastic Surgery and Laryngology (Dr. Erich), Mayo Clinic and Mayo Foundation. The Mayo Foundation, Rochester, Minn., is a part of the Graduate School of the University of Minnesota.

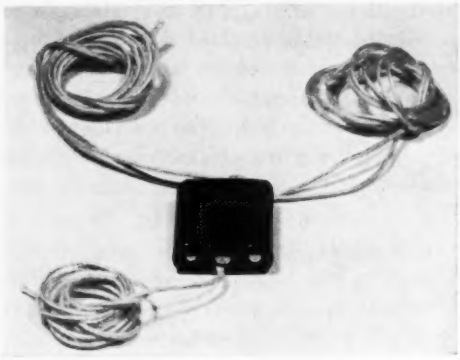


Fig. 1.—Intracavitary nasopharyngeal radium applicator.

the bottom of the applicator when the tubes have been pulled into place. The tubes are retained in position by tying the strings tightly against the top end of the applicator. The Bakelite wall surrounding each tube is 1.0 mm. thick, and there is 1.5 mm. separation between adjacent tubes. The strength of each radium tube is 50 mg., and the active length is 1.2 cm.; over all, each tube is 1.9 cm. long and 0.4 cm. in diameter. Filtration is with 1.0 mm. of platinum.

USE OF APPLICATOR

The applicator is placed in the nasopharynx by passing the strings from the top of the applicator out through one or both nasal cavities and drawing the applicator through the mouth and up into the nasopharynx, where it is immobilized. When the applicator has been seated in the nasopharynx, the trailing string emerging from the center hole at the bottom of the applicator projects from the patient's mouth; this string is necessary for withdrawal of the applicator (Fig. 2).

The strings facilitate easy and adequate adjustment of the plaque of radium in the nasopharynx so that complete coverage of the lesion can be obtained. Alternate traction on the strings in the nose and on the string emerging from the mouth regulates the position of the applicator in a vertical direction. Horizontal positioning is accomplished by passing all of the strings from the top of the applicator through the same side of the nose or by dividing the strings and passing some through each side of the nose; when all of the strings are introduced through one nasal chamber, the plaque is directed laterally in the nasopharynx (Fig. 2), but when they are introduced through both nasal cavities the appliance becomes centered in the median line (Fig. 3). It is thus possible to guide the applicator and retain it directly over the lesion to be irradiated. If the dimensions of the growth are greater than the active area of the plaque, it is easy to alter the position of the applicator at intervals so as to obtain adequate coverage of the tumor.

The insertion of the applicator into the nasopharynx requires cocainization of the nose, oropharynx, and nasopharynx. For this purpose, we usually employ a 10% solution of cocaine hydrochloride, which can be applied to the mucous membranes either topically or by spray. A small rubber catheter is introduced into each nostril, pushed through the nose and nasopharynx, and brought out through the mouth. The strings on the upper end of the radium plaque are

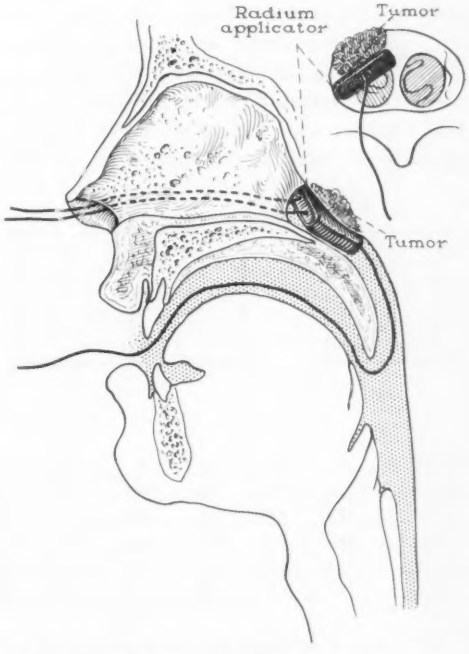


Fig. 2.—Applicator in lateral position in nasopharynx.

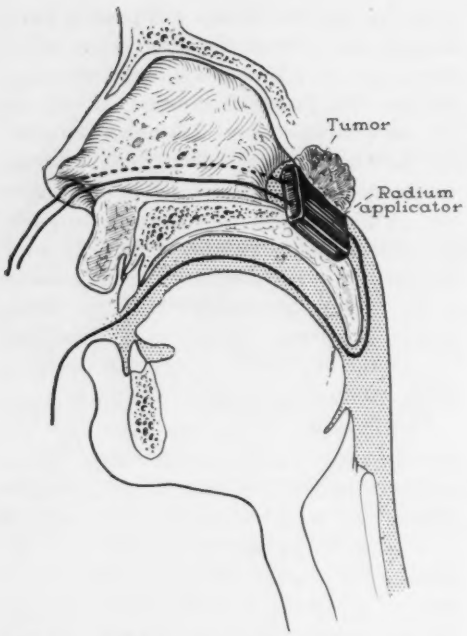
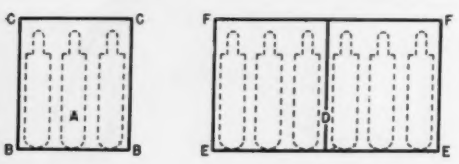


Fig. 3.—Applicator in medial position in nasopharynx.

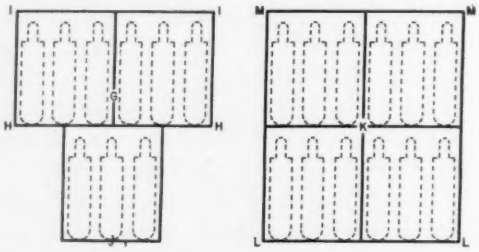
separated and tied to the tips of the catheters, which, when withdrawn through the nose, pull the applicator through the mouth and into the nasopharynx in the median line. To immobilize the appliance in this position, the strings emerging from the nostrils are tied together over the columella. If it seems desirable to direct the applicator to one side of the nasopharynx, only a single catheter is inserted on the involved side. Under these circumstances, all of the strings come out of one nostril, and the plaque is retained in proper position in the nasopharynx by attaching the strings to the cheek with adhesive tape.

DOSAGE

Our technique has been to administer radium therapy within the nasopharynx rapidly, with treatments of only a few hours' duration. This is possible because the applicator is loaded with three 50-mg. tubes of radium. The critical dose is the minimal dose delivered to the tumor. Ordinarily this would be the dose delivered to the deepest portion of the tumor at its periphery. Since there is a rapid fall-off of the dose at the corners of the applicator, it is important that the applicator (whether used as a single field or multiple adjacent fields) well overlap the outermost periphery of the lesion. We always attempt to deliver a minimal tumor dose of 3000 gamma roentgens. This dose can be administered safely in most cases if the tumor does not exceed 1 cm. in thickness. If the tumor is thicker, one must usually be content to deliver the maximal safe dose (3000 to 3500 r at a depth of 1 cm.) and trust that the supplementary external roentgen therapy will compensate for the decreased dose to the deeper portion of the tumor.



Depth	A	B	C	D	E	F
Surface	1976	562	196	1022	323	132
0.5 cm.	720	345	179	480	211	122
1.0 cm.	343	218	141	261	144	100
1.5 cm.	198	147	109	164	104	81
2.0 cm.	129	104	84	111	78	65



Depth	G	H	I	J	K	L	M
Surface	710	256	99	336	379	182	80
0.5 cm.	353	178	92	200	262	128	76
1.0 cm.	205	128	78	126	180	94	66
1.5 cm.	136	95	64	91	128	73	56
2.0 cm.	96	74	53	69	94	58	47

Fig. 4.—Dosage data for intracavitary applicator. Dosage is tabulated in gamma roentgens per 100 mg-hr. (total milligram-hours for entire treatment area) for various points beneath applicator at different depths.

Figure 4 gives dosage data for the intracavitary applicator for single-field therapy and for several combinations of multiple fields. As a general rule, the maximal safe treatment time for a single area is 6 hours of continuous application (900 mg-hr.); for two adjacent areas it is 4½ hours per area (675 mg-hr. per area, or a total of 1350 mg-hr.); for three adjacent areas it is 4 hours per area (600 mg-hr. per area, or a total of 1800 mg-hr.); for four adjacent areas it is 3½ hours per area (525 mg-hr. per area, or a total of 2100 mg-hr.).

Intracavitary radium therapy for squamous-cell carcinoma of the nasopharynx should always be supplemented with external roentgen therapy. Both the technique and the total dose necessarily vary according to the extent of the tumor in any particular case, but generally fractionated treatment is indicated through multiple ports to bring the total radiation dose to a level that may be cancerocidal.

SUMMARY

Described is an intracavitary nasopharyngeal radium applicator that we have found useful to supplement x-ray therapy in the treatment of squamous-cell carcinoma of the nasopharynx. The applicator is simple in design and inexpensive to construct. We have treated approximately 30 patients with it during the past three years and have not encountered any untoward complications from its use.

Treatment of Impaction of Cooked Meat in the Esophagus with Trypsin

JOSEPH M. MILLER, M.D.
and
GEORGE C. GODFREY, M.D., Fort Howard, Md.

Obstruction of the esophagus in a patient with achalasia may be associated with the retention of a large amount of food in the esophagus. The mechanical removal of such material through the esophagoscope may be a tedious and a dangerous problem if much food in particles of moderate size is present. The removal of accumulated food in a patient with achalasia, however, was readily accomplished by the instillation of trypsin (Tryptar) into the esophagus. The use of an air-vent suction system in conjunction with the trypsin offered an additional advantage in that possible aspiration of digested food into the lungs was prevented.

REPORT OF A CASE

A 50-year-old white man was admitted to the hospital on Sept. 3, 1953, with a chief complaint of progressively severe inability to swallow solid food of about one year's duration. The roentgenograms of the esophagus after the administration of barium showed a stricture about 2 cm. long at the esophagogastric junction, with dilatation of the esophagus proximal to the constriction. At esophagoscopy on Sept. 8, a large amount of food which consisted mostly of cooked meat was found in the esophagus. The food was partially removed, but the patient became too tired to permit complete removal. Two Levin tubes were placed in the esophagus, and 0.125 gm. of trypsin * in 12 cc. of Sorensen's phosphate buffer solution was instilled through one of the Levin tubes every 12 hours from Sept. 10 for four times. Both Levin tubes were occluded for four hours, and then air-vent suction drainage was provided by attaching a Stedman pump to one of the Levin tubes for eight hours until the time for the next instillation of trypsin. At esophagoscopy on Sept. 10, the esophagus did not contain food and was normal except for the stricture at the lower end. Progressive dilatations of the constriction of the esophagus, until a No. 26 F. bougie was passed, were done. Aerostatic dilatation under fluoroscopy was then performed. The patient was able to swallow all types of food, gained weight, and was discharged from the hospital on Oct. 16. At follow-up examination on Nov. 16, he was swallowing well. On March 23, 1954, the patient had not had a recurrence of symptoms and he had gained about 14 lb. in weight.

In order to determine the comparative rate of digestion of enzymes which might be used to digest meat in the esophagus, a series of experiments using trypsin, Caroid (powder containing a proteolytic enzyme obtained from the fruit of Carica papaya),† proteinase A (obtained from the Streptomyces proteolyticus),‡ and isotonic saline, as a control, were done. Trypsin, 0.125 gm. in 10 cc. of Sorensen's phosphate buffer solution, Caroid, 10 cc. of a 10% suspension in isotonic saline, proteinase A, 30,000 units in 10 cc. of isotonic saline, and 10 cc. of isotonic saline were used. The solutions were added to test tubes containing 10 cubes of cooked beef measuring about 0.5 cm. on a side and to test tubes containing shredded cooked beef. The test tubes were incubated at 37.5 C for 24 hours. All tests were done three times. The results of digestion are shown in the Table. In all instances a fine residue was present when

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Surgical Service, Veterans Administration Hospital.

* The trypsin was supplied by the Armour Laboratories, Armour and Company, Chicago.

† The Caroid was supplied by the American Ferment Company, New York.

‡ The proteinase A was supplied by Sharp & Dohme, Division of Merck & Co., Inc., Philadelphia.

Digestion of Cooked Meat

Agent	Type of Meat	Time, Hr. 1	2	3	4	5	12	24
		Per Cent of Digestion						
Trypsin	Cubed	10	10	20	30	40	60	70
	Shredded	20	30	40	60	90	90	90
Caroid	Cubed	20	30	60	70	90	90	90
	Shredded	30	40	60	70	90	90	90
Proteinase A	Cubed	10	10	10	20	30	40	60
	Shredded	20	20	30	40	60	90	90
Isotonic Saline	Cubed	0	0	0	0	0	0	0
	Shredded	0	0	0	0	0	0	0

maximum digestion in each test tube was obtained. The pH values of the solutions as determined once with nitrazine paper about four hours after the incubation was started were trypsin about 6.8, Caroid about 4.8, proteinase A about 6.5, and isotonic saline about 6.8. Aerobic and anaerobic cultures of the solutions of trypsin, proteinase A, and isotonic saline before being added to the cooked beef were sterile in broth and on cystine-trypticase agar. Aerobic and anaerobic cultures of the Caroid and of the suspension of the Caroid in broth and on cystine-trypticase agar showed a Gram-positive Micrococcus.

l-Cysteine hydrochloride, 0.02 gm., was added to a test tube containing the 10% suspension of Caroid and the cubed beef. A change in the rate of digestion was not noted, but the residue was composed of finer particles than without the *l*-cysteine hydrochloride. The addition of *l*-cysteine hydrochloride, after digestion of the beef by the Caroid had occurred, produced the same fine particles.

CONCLUSIONS

The digestion of cooked beef can be accomplished in varied degree by trypsin (Tryptar), Caroid, and proteinase A. Caroid was the most effective in vitro. For in vivo use, trypsin is recommended, since it is sterile, the solution can be made easily, and the mixture can be given readily. An optimal pH can be produced in the esophagus by the use of Sorensen's phosphate buffer solution as a solvent for the trypsin. Air-vent suction removes the products of digestion until the particles are small enough to pass the site of obstruction spontaneously. The use of trypsin to digest meat causing obstruction of the esophagus warrants further trial in patients.

The Threshold Sensitivity of the Tympanic Muscle Reflexes

ERNEST GLEN WEVER, Ph.D.
and
JACK A. VERNON, Ph.D., Princeton, N. J.

That the muscles of the middle ear are normally made to contract through a reflex action of sound was first clearly indicated by the work of Hensen [1] in 1878. His experiments were carried out on dogs and were concerned only with the tensor tympani muscle, which was seen to contract when a loud sound was applied to the ear. Similar observations were made by Kato [2] in 1913 on the stapedius muscle, with cats and rabbits as the experimental animals. Since then there have been many further experiments on these and other animals, including man, in which the reflex responses of these muscles have been demonstrated. So far, however, little has been reported on the intensities of the sounds required to elicit the reflexes.

The most extensive quantitative results were obtained by Lorente de Nó and Harris [3] on the rabbit by visual observations of the muscle action. They measured the reflex thresholds of the two muscles for numerous tones from 128 to 16,384 cycles, and though they did not have any absolute calibration of their sounds, they were able to represent the intensities in relation to the absolute threshold of tonal sensitivity in man. They found that for the principal portion of the auditory range the muscle reflexes were elicited only when the stimulating tones were far above the human threshold. This level was somewhat higher for the tensor tympani than for the stapedius muscle for tones below 3000 and above 10,000 cycles, and there was little or no difference for tones between 3000 and 10,000 cycles.

Jepsen,[4] working with human subjects, likewise found that only very intense sounds will elicit the muscle responses. He used the impedance method, which depends upon the fact that a contraction of the muscles alters the acoustic impedance of the ear as measured at the external auditory meatus. He measured the threshold for the combined action of the two muscles, and obtained intensities about 80 db. greater than the intensities required for a threshold perception of tone in the same subjects, for all frequencies from 250 to 4000 cycles.

It should be noted further that Hammerschlag [5] in 1899 first proved that the tensor tympani reflex is bilateral, and Lüscher [6] later found that the stapedius reflex is as easily elicited by applying sound to the opposite ear as to the ear in which the action is being observed. Lindsay, Kobrak, and Perlman [7] verified Lüscher's observations.

The present experiments are concerned with the threshold sensitivity of the tensor tympani and stapedius reflexes in the cat, and include absolute measurements of the sound pressure required to elicit these reflexes. The experiments were carried out on 30 cats.

METHOD AND PROCEDURE

The animals were anesthetized with pentobarbital sodium and then decerebrated, after which an interval of two hours or more was given for recovery from the anesthetic and from operative shock. After such recovery bodily reflexes of various kinds were readily

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aroused. One animal was discarded because it failed to show a suitable degree of recovery, and two others because they were found to have middle-ear infections.

In the usual procedure the middle ear was exposed on the right side by a wide opening of the auditory bulla. The bony septum that divides the bulla cavity into anterior and posterior chambers was removed, exposing the drum membrane and the tensor tympani muscle. Removal of the spicule of cartilage that supports the chorda tympani nerve gave a clear view of the stapes and the stapedius tendon.

The contractions of the tensor tympani muscle could then be observed by visual means either directly or in terms of the displacements of the manubrium of the malleus, and the contractions of the stapedius muscle could be observed similarly through their effects on the head of the stapes. For this purpose we used a binocular microscope giving 15 $\times$ magnification.

The further procedure varied accordingly as other methods were used for recording the actions of the muscles. In most of the experiments a strain gauge was employed to indicate the forces of contraction. In its application a fine silk thread was tied to the tendon of one of the muscles and then run along the line of the tendon to the operating arm of the strain gauge. For the tensor tympani muscle this line of action is in a ventrolateral direction, and the thread was passed directly out of the bulla cavity. For the stapedius muscle the line of action is medial, and it was necessary to add an extension to the operating arm of the gauge so that its end could be inserted into the bulla cavity itself. This extension consisted of a thin strip of metal bearing a steel needle at its tip; the thread was passed through the eye of the needle and this end was located in the bulla cavity by means of a manipulator, after which the thread was drawn taut and secured about the needle's shank. The strain gauge (made by the Statham Company) consisted of an arrangement of four resistance wires in a Wheatstone bridge network. An alternating current of 400 cycles at 10 to 15 volts was supplied to the bridge and then, with no tension on the operating arm, the bridge was balanced to zero. The application of tension to the operating arm produced a stretching of two of the wires and a relaxation of the other two, thus unbalancing the bridge and producing bridge currents that were read on a sensitive vacuum tube voltmeter. The gauge was calibrated by suspending weights from the operating arm or its extension. It had a sensitivity of 3 mg. as used for the tensor tympani measurements and one of 1.3 mg. when the extension arm was added as in the stapedius measurements.*

In most of the experiments a platinum foil electrode was placed on the round-window membrane of the right ear and the cochlear potentials produced in this ear in response to sounds were measured on a wave analyzer. Sometimes the left ear also was exposed for the recording of cochlear potentials.

Sounds were delivered, usually to both ears, through tubes connected to two loud speakers. These loud speakers were actuated by separate channels containing oscillators, attenuators, and amplifiers. Also, the channel used for excitation of the acoustic reflexes was provided with an electronic switch that delivered the tones with controlled rates of onset and decay. The onset used in these experiments was made as brief as possible without producing an audible click; this onset time from zero to full intensity was 5 milliseconds. The duration of the tone was 2 seconds.

Each of the sound tubes was connected to a special cannula that was tied into the external auditory meatus, after removal of the pinna. A probe tube, attached to a condenser microphone, was introduced into the cannula from one side so as to terminate at its end in the near vicinity of the drum membrane. By means of the probe tube and microphone a measurement was made of the absolute sound pressure of every stimulating tone.

* For further details of the strain-gauge measurements, see Wever, Vernon, and Lawrence.[8]

When a steady tone was being delivered to the right ear and some given magnitude of cochlear potential was being recorded from this ear, some other tone could be introduced into the left ear at an intensity sufficient to elicit an acoustic reflex. Its contralateral effect was then seen as a change in the magnitude of the cochlear potentials of the right ear because of a modification of the sound transmission characteristics of this ear.

It must be noted that under these conditions the tone in the left ear had no direct effect upon the observed potentials from the right ear, even though this tone was conducted across the head to some extent, for at the intensity at which this tone appeared in the right ear it was well below the muscle reflex threshold and also below the level of distortion. It added its component to the cochlear potentials, to be sure, but the selectivity of the wave analyzer was such that this component was not recorded when the frequencies of the two tones were well separated, as they were in all these experiments.

As a test to show the absence of any direct effect of the sound transmitted across the head we cut both tendons in the right ear and stimulated the left ear with sounds well above the reflex thresholds. There was no alteration of the cochlear potentials recorded from the right ear.

It was not possible to make ipselateral observations of the muscle reflexes in terms of cochlear potentials. When a steady tone of any desired intensity is being delivered to one ear and its resulting cochlear potentials are under observation, and then another tone is applied to this same ear at an intensity high enough to elicit the acoustic reflex, this tone will have a direct effect upon the generation of cochlear potentials in response to the first tone. This is the phenomenon of interference, a form of intensity distortion described in detail elsewhere.† The reflex-exciting tone always overloads the ear and causes a diminution of the responses to any other tone that is simultaneously present, whatever its frequency. In some of the exploratory experiments we attempted to carry out the ipselateral type of procedure with the cochlear potentials, but soon recognized the presence of the interference phenomenon, and because we could not discriminate between a reduction from this cause and one resulting from muscle activity we abandoned this method and thereafter used only contralateral stimulation while observing the cochlear potentials.

We have now described three ways of studying the reflex activity of the tympanic muscles: by visual observations, by strain-gauge measurements, and by cochlear-potential measurements. For the visual and strain-gauge observations the stimulation may be either ipselateral or contralateral, but for the cochlear-potential measurements they may only be contralateral. All five of these variations of method were used in the present experiments, and often two, three, or four of them were used in the same animal.

Usually at the beginning of an experiment the two muscles were left attached to the ossicular chain, but often, after a set of observations had been made on the activities of the two muscles in combination, one of the tendons was severed and the actions of the remaining muscle were studied. Both cochlear-potential and strain-gauge measurements were made under these different conditions.

RESULTS

The results shown in the first three figures were obtained from cochlear-potential measurements with contralateral stimulation. In all of these a tone of 450 cycles was introduced into the right ear and maintained at an intensity that produced a potential of approximately 50μv. While this potential was being observed on the meter of the wave analyzer a tone of some other frequency was suddenly delivered to the left ear. The intensity of this contralateral tone was at first well below that required to elicit the acoustic reflex, and then was raised by steps of 5 or 10 db. until a perceptible re-

† References 9 and 10.

duction in the magnitude of the 450-cycle potential gave evidence that a muscle contraction had occurred. Then the intensity region was explored in steps of 2 db. to locate the reflex threshold more exactly. The precaution was taken to interpose a delay of 30 seconds or more after every trial in which a contraction was indicated. This rest interval serves to minimize both a fatiguing of the muscle and a sensitization of the reflex, both of which effects have been observed and which produce considerable variations of the threshold when trials follow closely upon one another. With suitable rest intervals the thresholds are repeatable over long periods of time, except when the ear becomes damaged by overstimulation.

In the results reported here the threshold was taken as the least sound intensity producing a noticeable reduction in the magnitude of the 450-cycle potentials. This point is emphasized because under many conditions there is another threshold, which is indicated as an increase in this potential and is produced by a sound intensity a little below that of the reduction threshold. The threshold of increase is a less regular phenomenon than the other, and its counterpart is rarely seen in the strain-gauge measurements, and therefore we leave it out of immediate consideration in this paper, though we shall refer to it again in the explanation of some of our results. We are continuing our investigation of it and shall report upon it in detail at a later date. The least reduction of cochlear potential that was perceptible under our conditions was 1 to 2μv, and thus represented a change of about 0.3 db. in the magnitude of the potential. Such a change if translated into the loudness of a tone would be barely perceptible to a well-trained human subject under ideal conditions of observation.

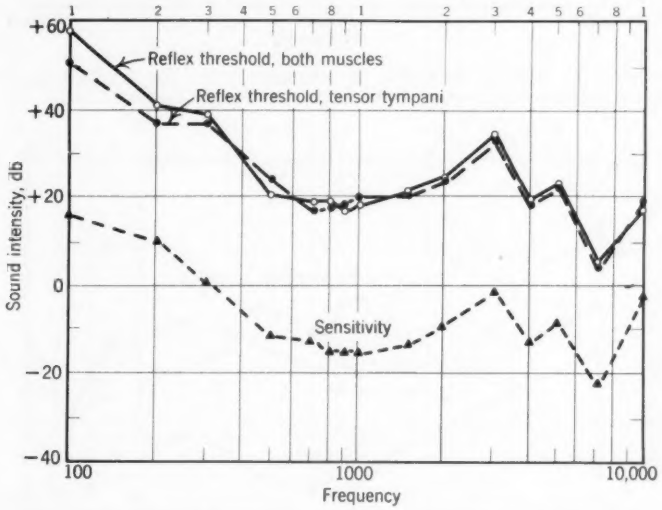

Fig. 1.—Contralateral reflex thresholds for both muscles and for the tensor tympani muscle alone after cutting the stapedius tendon, observed in the right ear as a diminution of cochlear potentials to a steady tone of 450 cycles. Below is a sensitivity curve for the left (contralateral) ear.

The solid line of Figure 1 shows results from one animal when both muscles were intact and the contralateral ear was stimulated with various tones from 100 to 10,000 cycles at an intensity barely sufficient to evoke the acoustic reflex. The intensity of these tones is represented in decibels relative to 1 dyne per square centimeter. Thus for 100 cycles the threshold intensity was 58 db., or 794 dynes per square centimeter. As the frequency was raised this intensity fell to a minimum of 17.3 db., or 7.3 dynes per square centimeter, at 900 cycles and

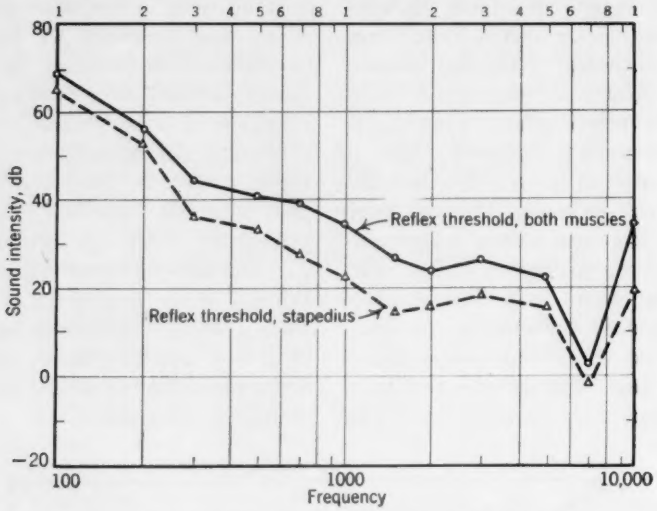

Fig. 2.—Contralateral reflex thresholds for both muscles and for the stapedius muscle alone after cutting the tensor tendon, observed in the same manner as in Figure 1.

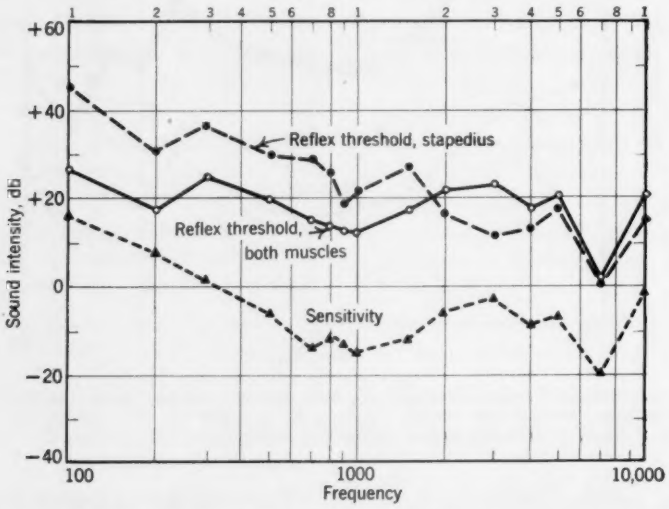

Fig. 3.—Contralateral reflex thresholds for both muscles and for the stapedius muscle alone, observed in the same manner as in Figures 1 and 2. The sensitivity curve is for the left (contralateral) ear.

thereafter rose rapidly to a high value at 3000 cycles. A second and more striking minimum appears at 7000 cycles, where the intensity is 6 db., or 2 dynes per square centimeter. After the stapedius tendon had been severed the results shown by the long-dashed curve of Figure 1 were obtained. It is apparent that for most of the tones the tensor tympani muscle alone gives results closely similar to those for the two muscles in combination, and only for the lowest tones is there an appreciable difference. For these low tones the tensor tympani muscle acting alone has a somewhat lower threshold than the two muscles in combination.

Figure 2 shows results obtained on another animal for the two muscles in combination (solid line) and for the stapedius

alone after the tensor tympani tendon had been severed. For both conditions the intensity falls fairly regularly as the frequency rises until a minimum is reached at 7000 cycles. For the whole range the stapedius threshold is lower than that for the two muscles in combination.

Figure 3 shows further results in which the thresholds were first obtained for the two muscles in combination (solid line), and then the tensor tympani tendon was cut and thresholds were obtained for the stapedius muscle acting alone. Here, for all tones up to 1500 cycles, the stapedius threshold is above that for the two muscles, and then for the higher tones this relation is reversed.

It is at first a little puzzling to find, as we do in all three of these figures for certain of the tones, that a single muscle may have a lower reflex threshold than this same muscle in association with its partner. The explanation seems to lie in the fact that the minimal actions of the two muscles may have different and even counteractive effects upon the transmission properties of the ear.[8] The appearance of an increase in cochlear potential as a result of the acoustic reflex has already been mentioned, and it is possible that at certain intensities of a given tone one of the muscles is acting so as to produce an increase and the other so as to produce a decrease of response. If the two effects are in balance the result will be no change until at some higher stimulating intensity this balance is upset. When only one muscle is present, the observed threshold may be above or below that for the two muscles in combination or it may be the same. We have seen all of these relations in the preceding figures. Other animals have given results in which the curve for the stapedius muscle alone is closely similar to that for the two muscles throughout the frequency range. In general we may say that we have not found any systematic difference in the behavior of the two muscles. There are large individual differences, as evidenced in the above figures.

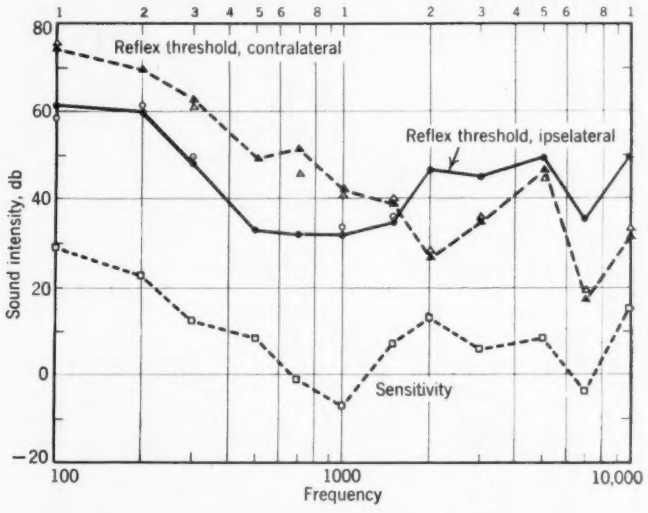

Fig. 4.—Contralateral reflex thresholds obtained by cochlear-potential observations (unfilled triangles) and by strain gauge (filled triangles), and ipselateral reflex thresholds obtained visually (open circles) and by strain gauge (filled circles). At many points the open and closed circles are coincident. The sensitivity curve is for the right (ipselateral) ear.

Figure 4 presents four sets of observations with both muscles intact. Contralateral thresholds obtained by means of cochlear potentials, as in the preceding figures, are shown by the unfilled triangles. The filled triangles, through which the broken curve

is drawn, represent strain-gauge observations made with a thread tied to the right tensor tympani tendon, and with stimulation of the left ear with various tones. There is close agreement between these two sets of contralateral observations. The open circles represent visual observations of contractions of the tensor tympani muscle in the right ear while this same ear is stimulated with tones. The filled circles represent strain-gauge observations from the right tensor tympani muscle while this ear is stimulated. There is also close agreement between these ipselateral observations. There are differences between the contralateral and the ipselateral thresholds, but these differences are no greater than we commonly find between two different ears measured in the same way, as may be judged by comparing the first three figures.

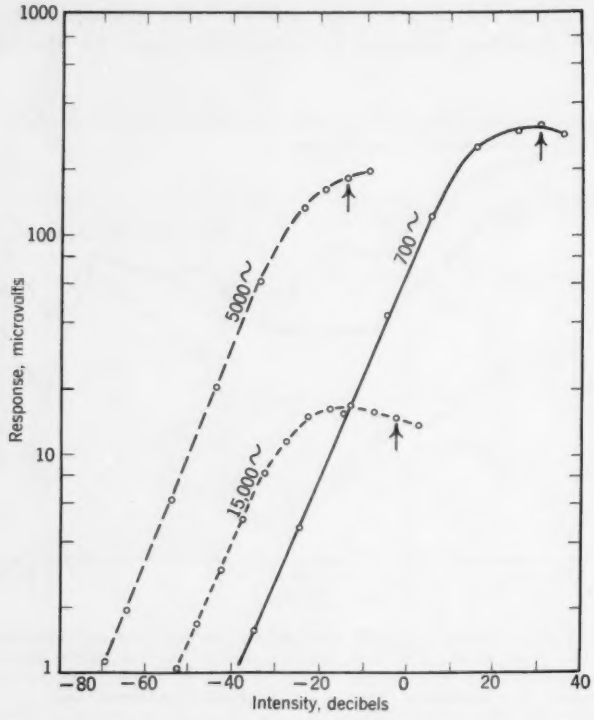

Fig. 5.—Intensity functions for the cochlear potentials obtained for three frequencies, showing by the arrows the intensity at which the muscle reflex occurred.

It is evident that the different methods of observing the reflex action—the visual, strain-gauge, and cochlear-potential methods —are equivalent in the results that they yield, when the conditions are favorably arranged for their use.

In Figures 1 and 3 curves have been given representing the sensitivity of the left ear, the ear that is being stimulated with various tones to elicit the muscle action. These curves show the sound intensity in the left ear necessary to produce a cochlear potential in this ear of 50 μv. (Because the intensity function for the cochlear potential is linear over its principal range, these curves would have the same form if any other constant magnitude of potential were required, up to the level of overloading.) It will already be apparent that the reflex threshold follows closely the form of the sensitivity as expressed in this manner. There are occasional variations, most conspicuous in the points for 100 and 200 cycles in Figure 3, but the general similarity of the functions

is striking. This similarity has been observed in every animal in which these measurements have been made. It is observed again in Figure 4, in which the sensitivity function is the 50-μv curve for the right ear and is therefore to be compared with the ipselateral thresholds.

It is clear that the acoustic reflex threshold is a function of the ear's sensitivity as reflected in the cochlear potentials. It is not a simple function of these potentials, however. It does not correspond to any given output of cochlear potential. A curve representing the magnitude of the cochlear potentials produced by tones at the reflex threshold in the same ear does not bear any close resemblance to the threshold curve itself. This cochlear-potential curve is different in form from the sensitivity curve because for all tones the intensities required at the reflex threshold fall in the nonlinear or overloading portions of their cochlear-potential functions, and for different frequencies these portions of the curves have somewhat different shapes.[11] Moreover, there is a good deal of latitude in the point within these portions where the reflex may occur.

These features are illustrated in Figure 5. Here the intensity functions have been drawn for three tones, and the arrow below each curve indicates the point at which the acoustic reflex was elicited. For the 5000-cycle tone the reflex occurred before the maximum was reached, for the 700-cycle tone at the maximum, and for the 15,000-cycle tone well beyond the maximum. These examples were chosen to show the possibilities; actually the reflex may appear at any point in the region of the maximum, and there is no regular rule for its appearance or any special relation to the frequency of the tone except perhaps for the very high tones, for which it usually appears well beyond the maximum.

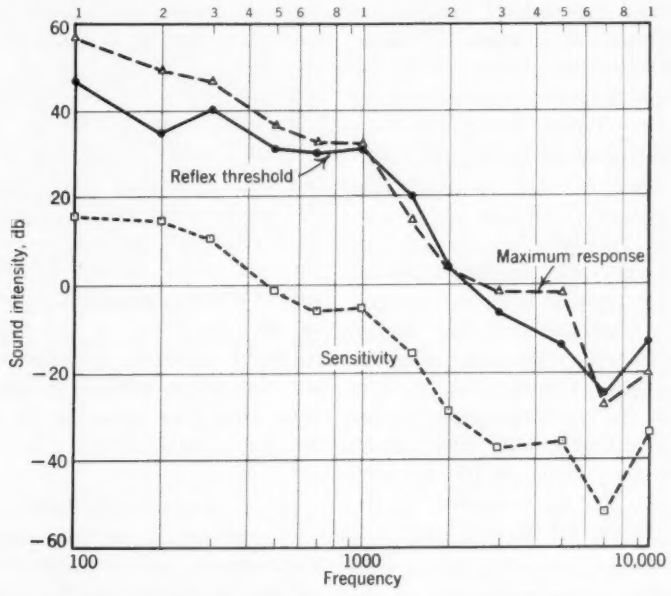

Fig. 6.—Comparison of the ipselateral reflex threshold as obtained by strain-gauge observations, with the sensitivity function and the function showing the intensity required to produce a maximum cochlear potential in the same ear.

Some further relations are shown in Figure 6. Here the solid-lined curve presents the ipselateral reflex thresholds as determined by strain-gauge observations on the tensor tympani muscle. The long-dashed curve shows the stimulus intensities required

for the same tones to produce maximum magnitudes of cochlear potential; thus this figure presents data corresponding to the abscissa values below the arrows of Figure 5. These two functions correspond closely, and are also similar in form to the sensitivity curve shown below.

As already indicated, the normal responses of the tympanic muscles are true acoustic reflexes. Hammerschlag's experiments in 1899 revealed much of the neural pattern for the tensor reflex: This reflex takes a path through the cochlear nerve and the cochlear nucleus of one side to both ipselateral and contralateral trigeminal nuclei, probably passing through the trapezoid body. Because we believe that the cochlear potential is instrumental in exciting the fibers of the cochlear nerve, it follows that the cochlear potential carries the information that is made use of in the production of the reflex action. If this is so, we can account for the variability in the point of appearance of the reflex in the region of overloading; the cochlear-potential function is relatively flat here, the magnitude changing little over a considerable range of intensity. For example, in Figure 5 the response magnitudes for the last three points in the 700-cycle curve differ by only 10%, or 0.8 db. (for a stimulus change of 10 db.), and could not easily be discriminated in the operations of the central nervous system.

Because the reflex thresholds do not bear a simple relation to the magnitude of the cochlear potentials, but are more closely related to the sensitivity and, perhaps more significantly, to the intensities giving maximum values of cochlear potential, we suggest that the sensory action in the cat's ear that is represented initially by the cochlear potential undergoes an evaluation in the nervous system that possibly may be compared to that which in ourselves gives us the perception of loudness. More particularly, this evaluation is one in which the tones at the lower end of the scale, from 100 to 1000 cycles, which have nearly uniform maximum values of cochlear potential, receive an emphasis that is nearly proportional to frequency, and the remaining tones, for which the maximum values fall off regularly to about one-fifth in magnitude, receive an emphasis that varies greatly in different ears but nearly always more than compensates for the decline in the maximums.

A few investigators have made use of the tympanic muscle reflexes as an objective measure of the auditory sensitivity of animals. The results presented here provide a basis for evaluating this procedure. As shown, the reflex function is similar to the sensitivity function as represented by the cochlear potentials, but is not exactly the same. Moreover, the muscle actions appear only when the ear is being driven near its physiological limits, and the performance is characterized by considerable instability. Even more serious is the fact that in some animals a reflex contraction of the muscles can only be aroused by applying intensities that are seriously damaging to the ear. This more frequently happens for very high and very low tones, and when it does occur the animal becomes unsuitable for further study, as the thresholds at all frequencies are markedly elevated. For these reasons the acoustic reflex method of determining the ear's sensitivity is not to be recommended for general use.

SUMMARY AND CONCLUSIONS

A number of methods, utilizing visual, strain-gauge, and cochlear-potential observations, have been used to study the reflex thresholds of the tensor tympani and stapedius muscles of the cat in response to sounds. The results are expressed as the absolute values of the sound pressure for various tones over the range from 100 to 10,000 cycles that produce a just-detectable contraction of the muscle or a decrease in the transmission of sounds by the ear. No consistent differences were found between the reflex thresholds of these two muscles or between their excitation by ipselateral and contralateral stimulation.

The reflex thresholds vary with frequency in much the same manner as the sensitivity function of the ear under stimulation, as this

sensitivity is exhibited by the cochlear potentials. These thresholds show an even closer correspondence to the sound intensities required to produce maximum values of cochlear potentials. The reflexes are elicited only when the sound intensity reaches an extreme level, a level at which the inner ear is severely overloaded and indeed is in danger of serious injury. It is clear that in the cat, at least, the acoustic reflexes serve an emergency function, and appear only when the stimulation is near the limits of operation of the inner-ear structures. In fact, some ears fail to exhibit the reflex for certain tones—notably those at the two ends of the auditory range—until the intensities are raised to a destructive level.

Though some investigators have made use of the tympanic muscle reflexes as a means of measuring auditory function in animals, we regard this method as having serious limitations, in view of the extreme intensities required and the resulting instability of the ear's performance.

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Case Reports

PEMPHIGUS OF THE OROPHARYNX AND LARYNX

Report of a Case

SAMUEL WEINSTEIN, M.D.
and
AARON R. SACHS, M.D., Brooklyn

PEMPHIGUS [1] is defined as an acute or chronic disease of the skin occurring in several phases and sometimes accompanied by constitutional symptoms. It is characterized by bullae that develop in cycles or in continuous succession. There are several forms, but the commonest form occurring in this country is pemphigus vulgaris.

The lesions of pemphigus are bullae of various types and their sequels. By successive crops the disorder is continued over weeks, months, or years. The mucous membranes of the mouth and vagina may become invaded, and not infrequently the first manifestations of the disease are presented in the former situation.

The important histopathologic finding is acantholysis. This is a disappearance of the intercellular bridges of the epidermal cells.

St. Clair Thomson [2] says that pemphigus affecting the mucous membrane of the mouth and larynx is a rare affection. He says it is generally secondary to the skin eruption, but occasionally the eruption makes its appearance primarily and perhaps solely on the mucous surfaces. He states that in healing it may leave adhesions and stenosis in the nose; he merely mentions the fact that he has seen it persist for two years in the larynx but does not specify the type of lesion.

Submitted for publication Feb. 24, 1955.

From the Department of Otolaryngology, Jewish Hospital, Service of Dr. Samuel Weinstein.

Presented before the Section on Laryngology, Rhinology and Otology of the Medical Society of the County of Kings and Academy of Medicine of Brooklyn, Jan. 12, 1955.

Lee M. Hurd [3] reported a case of pemphigus involving the pharynx and base of the tongue without skin manifestations and said that pemphigus entirely limited to the mucous membrane is rare. He [4] reported another case involving the soft palate and laryngeal walls.

Gordon B. New [5] reported 29 cases of pemphigus, of whom 19 came primarily on account of lesions of the mouth. In his discussion he stated that in the mouth and throat the absence of scarring, as a rule, is conspicuous, although it may occur and may cause laryngeal obstruction; however, on the conjunctivae it may occur frequently. Of the patients who came primarily on account of the condition of their mouths and throats and later developed lesions of the skin, the interval between the appearance of the mucous membrane lesions and those on the skin was from a few weeks to three years. It is believed that the more rapid the appearance of the cutaneous manifestations following lesions of the mouth and throat the more virulent and rapid the course of the disease.

Hitch [6] recently reported two cases of pemphigus involving the larynx, in one of which the larynx became scarred and deformed, although the need for tracheotomy was not mentioned at the time of the report. Both of the cases eventually had skin manifestations.

Walter F. Lever [7] describes a type of pemphigus involving the mucous membranes only, which he calls benign mucous membrane pemphigoid. The outstanding features of this disease are a predilection of the lesions for the mucous membranes, particularly the conjunctival and oral mucosa, the tendency of the lesions to produce scarring, and the benign chronic course of the disease. Scarring is most frequently seen around the soft palate, uvula, and the tonsillar pillars and

between the alveolar ridges and the buccal mucosa. The uvula and tonsillar pillars may become destroyed, and the soft palate may become adherent to the posterior pharyngeal wall. Involvement of the larynx may lead to chronic recurrent soreness and hoarseness and to the accumulation of mucus in the throat. Examination of the throat in such cases shows vesicles and erosions in the larynx and occasionally also bands of adhesions. Lever does not discuss the need for tracheotomy.

Most patients are beyond the age of 60 at the onset of the disease, but the disease may begin in patients 30 to 60 years old. The disease pursues an extremely chronic course and as a rule does not affect the general health.

Lever raises the point that in a number of these cases acantholysis is absent and that therefore they are not cases of true pemphigus.

We are reporting a case of pemphigus limited to the oropharynx and larynx which had a duration of four years and in which skin manifestations were never present. It is a case of true pemphigus, as histopathological study showed acantholysis and, as will be seen, the pathology in the larynx was such that tracheotomy was necessary.

REPORT OF CASE

R. K., No. 383970, a white Jewish woman, 70 years of age, born in Russia, was admitted to the ward medical service of the Jewish Hospital of Brooklyn on May 21, 1954. She enjoyed good health until three to four years prior to admission. At that time she developed a soreness of the throat, which she believed was an ordinary cold, but on questioning there was no recollection of rhinitis, fever, cough, hoarseness, or generalized symptoms. As the soreness persisted, she visited a local physician, who prescribed a gargle, which she used for about six weeks, without relief, and at about this time she noted that she had blisters in her throat.

She visited the outpatient department of a city hospital in August, 1950, and was admitted to the hospital in September, 1950, with the complaint of pain in the pharynx and dysphagia. She was discharged after eight weeks with the diagnosis of mycotic infection of the mouth and pharynx. Studies there also indicated that the patient had hypertensive arteriosclerotic heart disease and diabetes. Unfortunately, no record was made of findings in the mouth according to the reports we received, nor were there included any reports on laryngoscopy, bronchoscopy, or esophagoscopy.

From then until admission to the Jewish Hospital of Brooklyn her complaints relative to her mouth, while persisting, were less bothersome than difficulty with breathing and severe substernal pains. These pains occurred every two days on the average and lasted for hours. The attacks were more frequent at night and accompanied by dyspnea. She obtained some relief by sitting upright. In the last year the dyspnea appeared during the day even without effort.

In the past three years she lost 20 lb. owing to poor appetite and lack of sleep associated with dyspnea. For the past one to two years she noted a nasal twang to her speech.

The admission physical examination showed the patient to be acyanotic, afebrile, and ambulatory but showing a dyspneic wheezing, stertorous respiratory sound. Examination of the mouth showed that she wore dentures and that in the buccal mucosa and hard palate there were white nonelevated plaques. The uvula was absent, and the soft palate was drawn toward the posterior pharyngeal wall. Auscultation of the lungs revealed prolonged expiration and terminal inspiratory and expiratory sonorous rales in both lung fields. Examination of the heart was recorded as follows: No cardiac enlargement to percussion. Regular sinus rhythm. Grade 2 systolic at base, with Grade 2+ systolic at apex: $A_2 = P_2$.

There was no clubbing of the fingers. Both legs showed varicosities and Grade 1 pretibial edema.

Fundoscopy: normal. Blood pressure: 144/70.

Impression: 1. Upper respiratory obstruction secondary to (*a*) adenoma of trachea or bronchi, (*b*) carcinoma of trachea, (*c*) endotracheal tuberculosis. 2. Chronic emphysema secondary to chronic respiratory obstruction. Ruled out: carcinoma of the lungs and arteriosclerotic heart disease.

The above is a résumé of the intern's admitting history and physical examination.

For the next few days the medical service investigated the patient on the basis of her circulatory and respiratory complaints, studying venous pressure, circulation time, pulse pressure, vital capacity and obtaining x-rays of the chest, sinuses and electrocardiogram and the usual blood and urine laboratory studies.

On May 26, 1954, the ear, nose, and throat service, being called in on consultation relative to her mouth lesions, obtained in addition to the aforementioned history the fact that the uvula had been removed about one year prior to admission, but she didn't know why. The examination was as follows:

Mouth: Tongue showed diffuse glossitis with several small bullae on undersurface, bleeding freely.

The buccal mucosa showed large flat raw areas as of ruptured blebs or bullae. The soft palate was distorted by (1) absence of the uvula and (2) adhesions of the posterior pillars to the lateral pharyngeal and posterior pharyngeal walls, creating only a small opening to the nasopharynx, about the size of a fingernail, ¼ by ½ in. There was complete fixation of the soft palate and no free margin except at site of uvula amputation.

The nasopharynx vault as visualized by posterior mirror rhinoscopy was seen as clear and devoid of masses, ulcers, exudate, or blebs.

Ears: Right and left, negative.

Larynx: The epiglottis was thickened, fixed, and adherent to the back surface of the tongue, eliminating the valleculae; the aryepiglottic folds seemed to be almost nonexistent, the arytenoids being pulled close to the epiglottis in each side, with just a small amount of fold on each side, leaving a very small opening superiorly into the larynx, giving the larynx the tubular appearance of a pseudosyrinx. The small opening above could be seen, it being less than about ½ in., but the interior of the larynx could not be seen, being concealed by this peculiar constriction of the superior aperture. It was our belief that this distortion was caused by healing of ulcerations and bullae of the hypopharynx and larynx. The patient's voice, however, was good, and so we have reason to believe that the cords were functioning normally.

Nose: Multiple polypi filled the middle meatuses of both sides.

Impression: Pemphigus vulgaris.

Ruled out: Blood dyscrasia, tuberculosis, and syphilis.

Advised: (1) Skin consultation, (2) x-rays of sinuses and chest, (3) biopsy of mouth mucosa, (4) endoscopy, and (5) tracheotomy.

The x-ray studies of the chest being reported negative and patient's main complaint being respiratory difficulty secondary to laryngeal obstruction, the ear, nose, and throat service requested that the patient be transferred to it for tracheotomy. To this the medical service agreed.

On May 28, 1954, the dermatological service wrote the following note: "Erosive bullae noted on the buccal mucosa and on the anterior surface of the soft palate. Also apparent is an adhesive process deforming the soft palate in its relationship to the nasopharynx. There is no history of any bullous lesions of the skin despite present illness of three to five years' duration. Impression: In the absence of skin lesions the definite diagnosis of pemphigus is uncertain. However, there is a mucous membrane type of pemphigus which may remain localized for a considerable period called pemphigoid, and which has ocular manifestations.

"Biopsy of the mucous membrane lesion should be done, although it is not as specific as on skin. If there is no contraindication [corticotropin] ACTH should be given as a therapeutic test. Differential would require ruling out erythema multiforme—due to drugs; duration and scarring is against this.

"Patient has stenosing lesions of the larynx which are probably on the same basis. Also there is a symmetrical fissuring keratoderm of both heels which I believe is secondary to obesity, weight bearing and fungus infection."

That afternoon some mucosal lesions (bullae and vesicles) were removed by excision from the buccal surface of the mouth and taken for pathological and histological study.

The pathological report showed acute inflammatory reaction with acantholysis compatible with the diagnosis of pemphigus.

Tracheotomy was performed by one of us (S. W.) on June 8, 1954, and the patient was started on corticotropin on advice of the dermatological service. She improved as regards dyspnea but still continued to complain of substernal and right shoulder pains. However, she seemed to be doing fairly well and was being kept in the hospital with the idea of having her well under the influence of corticotropin to see if it would have any effect whatever upon the fibrotic process in the oropharynx and larynx and also with the hope that if surgery were performed upon the larynx recurrence of the fibrotic stenosis might be prevented.

The patient did fairly well for about two weeks after the tracheotomy, but at this time developed a mild attack of cardiac decompensation, which responded to medical measures.

She recovered well enough so that a direct laryngoscopy could be performed in about 10 days. It should be explained that after our original laryngoscopic examination we were very doubtful about trying to enlarge the superior aperture by punching out some of the tissue because we thought that because of the pathology as described the patient could not have any sphincteric action here and with a large opening food and fluids might be aspirated. The question of a thyrotomy approach to the problem was discussed, but after this last laryngoscopic examination it was decided enough tissue could be removed from the superior aperture of the larynx to enlarge the airway with the possibility of subsequently being able to remove the tracheotomy tube, hoping, of course, that the corticotropin might prevent recurrence of the cicatricial closure.

The patient was watched by the medical staff as to diet, corticotropin, and other medical measures, and on July 19, 1954, she was taken to the operating room so that the procedure mentioned above could be performed but, while on the stretcher in the cor-

ridor outside the operating room, she developed acute pulmonary edema associated with anterior myocardial infarct (as indicated by an electrocardiogram) and died.

It should be mentioned that her blood studies were not unusual, her Mazzini test was negative, and much of the laboratory work dealt with guides to control and maintain the corticotropin therapy.

SUMMARY

A case of pemphigus vulgaris is presented in an elderly woman which was of four years' duration, involving the mouth, oropharynx, and larynx, without skin manifestations at any time, and which necessitated tracheotomy owing to the laryngeal stenosis caused by the pemphigus.

441 Ocean Ave.

1402 Avenue N.

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News and Comment

ANNOUNCEMENTS

Second Graduate Course in Plastic Surgery of the Head and Neck.—An intensive course in Plastic Surgery of the Head and Neck will be held at the Morrison Hotel, at Clark and Madison Streets in Chicago, from Oct. 7th to 9th, inclusive, 1955.

The course will be conducted by a faculty of outstanding specialists in this field and will be limited as to the number of participants and to recognized surgeons specializing exclusively in Otolaryngology and Ophthalmology and Plastic Surgery of the Head and Neck as set forth in the Directory of the American Medical Association.

Fifty-Third French Congress of Otorhinolaryngology.—The 53rd French Congress of Otorhinolaryngology will be held Oct. 17-22, 1955, at the College of Medicine of the University of Paris under the chairmanship of Prof. A. Aubin, of Paris, and the honorary chairmanship of Prof. Leon Binet, Dean of the College.

Numerous reports will be presented, and two particularly interesting ones will be discussed:

"Chronic Otitis in Childhood" (Bourdial, Debain, Coussieu)

"Deglutition and Its Disorders" (Mounier-Kuhn and A. Soulas)

There will be an exposition of surgical instruments, apparatus, and ENT specialties in the College Hall.

For further information, write to Mr. Raimond, Administrative Secretary, 17 rue de Buci, Paris, France.

EPIDERMOID CYST OF THE FRONTAL BONE

RALPH J. CAPAROSA, M.D., Pittsburgh

THE FOLLOWING case demonstrates the occurrence of an epidermal inclusion cystic tumor of the frontal bone which communicated with the frontal sinus. The course and management of this unusual entity is described.

REPORT OF CASE

A 34-year-old white man was admitted to the Veterans Administration Hospital, Aspinwall, Pa., with a 10-day history of an enlarging painful tender mass in the forehead, just superior to the midportion of the left eyebrow. The mass first appeared seven days after the onset of an upper respiratory infection. The progressive pain and swelling had not been ameliorated by massive doses of antibiotics. Examination showed an acutely ill man with a temperature of 104 F. Above the left eyebrow was a tense, tender, inflamed, fluctuant mass which measured 2 by 2 by 1 cm. From the left middle meatus exuded a small amount of thick, white, purulent secretion. Both nares were free of obstruction. X-rays showed a well-defined cystic area in the frontal bone superior and posterior to the frontal sinus. The sinus was diffusely clouded and had a thickened membrane. The left ethmoid and maxillary sinuses were, also, clouded. A radiologic diagnosis of epidermoid cyst of the frontal bone and chronic hyperplastic and suppurative sinusitis was made (Fig. 1).

Six years previously, after repeated attacks of sinusitis-like attacks associated with frontal swelling, an operation was performed on the left frontal sinus, presumably a simple trephination. Since this operative procedure the patient complained of frequently recurring headaches, occasional sharp frontal pain, persistent foul odor in the nose, and frequent rhinorrhea of white, thick, purulent secretion.

Incision of the forehead mass produced copious, thick, foul, green fluid which contained numerous thin white small flakes. The patient's acute symptoms subsided. One month later a left radical frontoethmosphenoidectomy was performed. The cystic

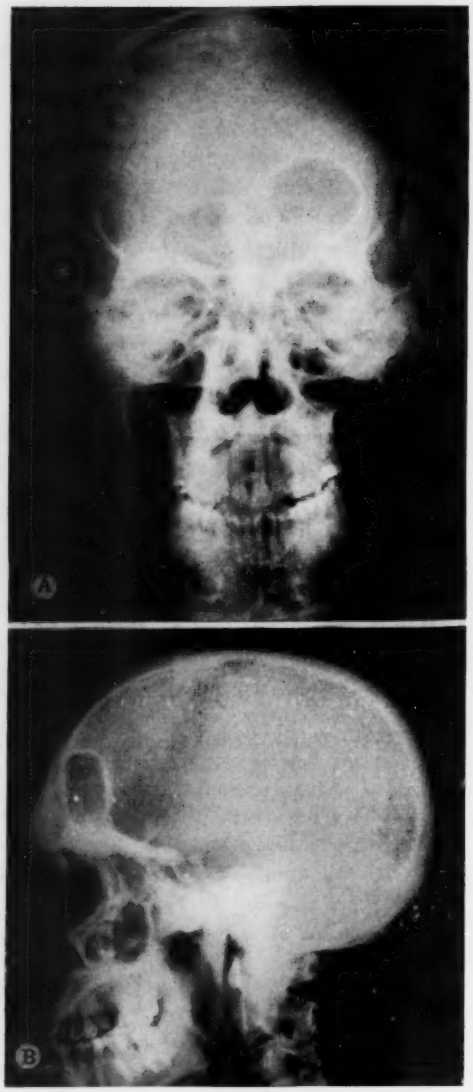


Fig. 1.—*A*, frontal x-ray showing well-defined bony walled cyst superior and lateral to the left frontal sinus. Left frontal, ethmoid, and maxillary sinuses are clouded. *B*, lateral x-ray showing cyst lying posterior to superior portion of frontal sinus and the inner table of frontal bone.

Submitted for publication March 21, 1955.

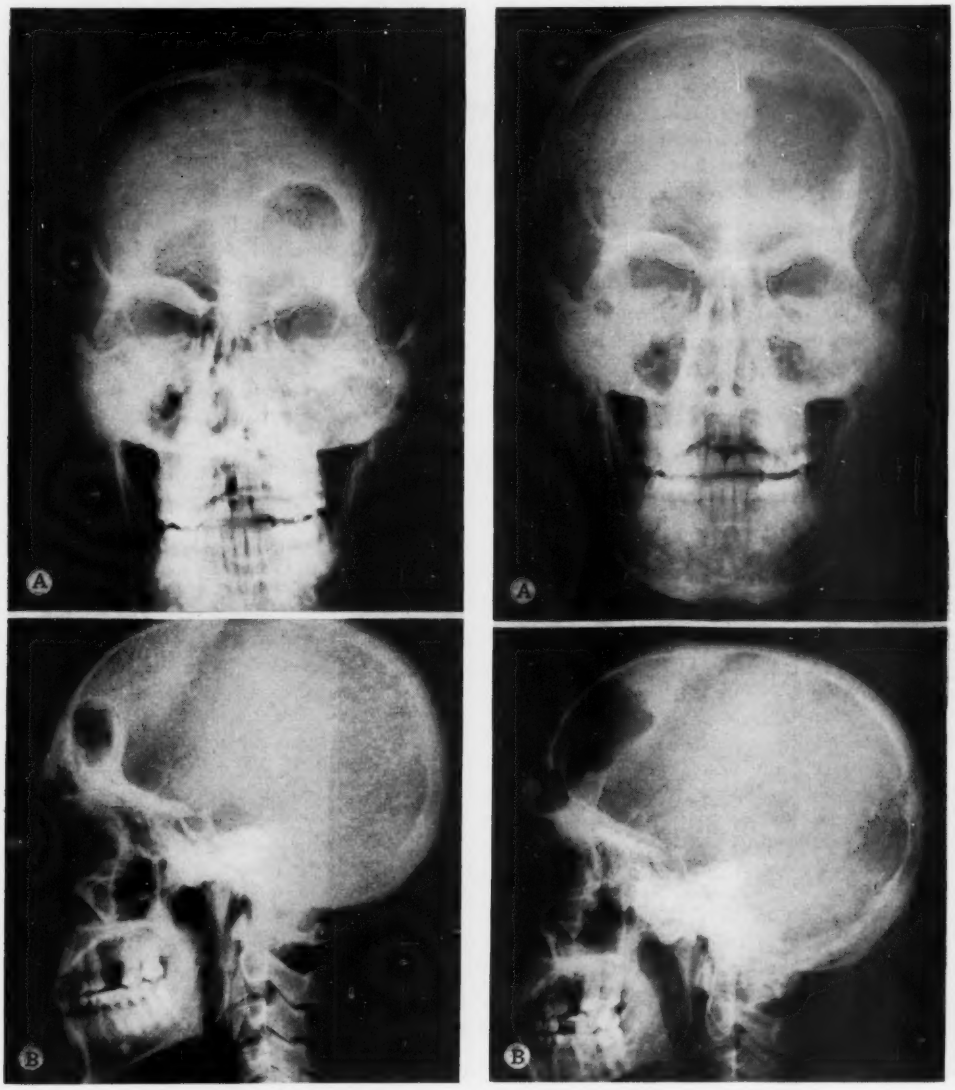


Fig. 2.—*A*, frontal x-ray following radical external frontoethmoidectomy. The inflammatory reaction in the sinus persists. The cyst wall is unchanged. *B*, lateral x-ray showing floor of frontal sinus partially removed.

Fig. 3.—*A*, frontal x-ray following craniectomy. Note the defect following removal of the skull plate and bony cyst. *B*, lateral x-ray following craniectomy.

area communicated freely with the frontal sinus over a wide space. The sinuses and the cystic area were exenterated of all the lining tissue. (Fig. 2.) A pathologic diagnosis of chronic sinusitis and epidermoid cyst was made. After this procedure the patient was well for two months. He then developed an abscess of the forehead similar to the one for which he had been admitted originally. Incision and drainage was again performed, and the patient's symptoms subsided. Prior to this episode the patient had had no vasomotor symptoms. The nasofrontal duct was probed with ease from below. A left radical craniectomy was performed, and the entire bone-walled cyst, which measured approximately 4 by 3 by 3 cm., was excised. (Fig. 3.) The tract of tissue leading to the area of original incision

and including the surrounding skin was removed. The proximal orifice of the nasofrontal duct was closed. A diagnosis of epidermoid cyst and chronic inflammatory tissue was made. The patient recovered uneventfully. There was a marked frontal deformity, which was corrected 10 months later by insertion of a stainless steel plate. The patient has remained symptom-free since that time, 18 months ago.

COMMENT

Epidermoid cysts of bone are uncommon tumors. The occurrence of a communication between this tumor in the frontal bone and the frontal sinus is an unusually rare situation. Adequate drainage which was accomplished through external frontoethmoidectomy was not sufficient to cure the lesion. A sustained result was effected only after craniectomy and radical excision.

SUMMARY

A case of frontal bone epidermoid cyst which communicated with the frontal sinus is presented. Its course and management is described.

402 Medical Arts Building.

Clinical Notes, New Instruments and Techniques

NEW SOFT PALATE RETRACTOR

ALEXANDER F. LASZLO, M.D., New York

Removal of the tonsils and adenoids is one of the commonest operations performed, but hardly any surgical procedure is done in a more hit-or-miss manner than this operation. Thorough removal of the adenoids has been especially neglected, probably due to some difficulty of accessibility and lack of control. In recent years, thanks to the writings of Reeves and Brill,* P. Guggenheim,[3] and Meltzer,[4] increasing emphasis has been paid to the thorough removal of the adenoids and also to the until now very much neglected enlarged salpingonasal and salpingopalatine folds, which, if present, cannot be seen by the ordinary technique. To do a good job and remove all the tissues from the upper part of the pharynx, they must be visualized, which frequently is quite a problem. Many operators are not even interested in seeing the result of their work. They go in once or twice with a curette or La Force adenotome, after which they turn over the patient, leaving nature to take its course. Others may use digital check-up, which I do not deem a satisfactory method. Many small pieces, especially around the fornix or around the Rosenmüller fossa, escape detection; they will certainly not locate the hypertrophic folds, which often cause the patient more trouble than ordinary adenoid tissue.

My experience coincides with that of the above authors, i. e., that the hypertrophied salpingonasal and salpingopalatine folds cause ear infection or reduce hearing by blocking the Eustachian opening. In many cases the unsatisfactory results of the operation are due to these tissues being left in situ. A secondary operation with consequent improvement is ample proof of this contention. To eliminate this failure, visualization of these structures is essential.

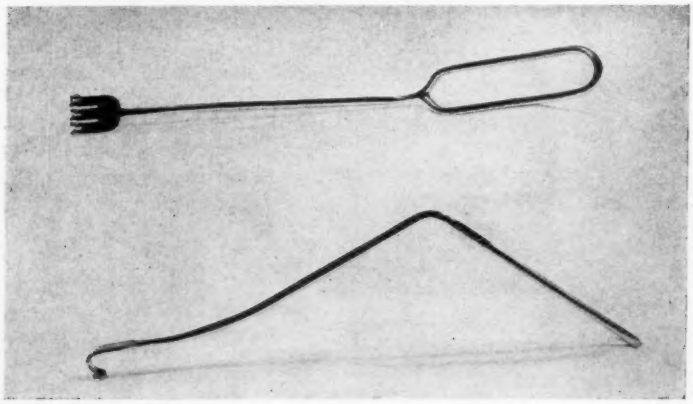
A good strong light, suction, a good anesthesia, and a proper soft palate retractor are essential for satisfactory exposure as a prelude to a successful operation. The palate retractors currently used (Hurd, Yankauer, Lothrop, Lewy) have not proved adequate in my hands during the long years of teaching this procedure. Since Reeves' description of the hypertrophic folds, these instruments have been absolutely inadequate for proper exposure. Therefore I experimented with a new soft palate retractor, which I designed. It has given me satisfactory results for the last two years. By pulling upward gently, we can expose the fornix and the Rosen-

Submitted for publication Feb. 21, 1955.

From the Oto-Laryngological Department of the University Hospital of the New York University-Bellevue Medical Center (Director: Dr. J. Daly). Associate attending of the University Hospital, Assistant Professor of the N. Y. U.

* References 1 and 2.

Fig. 1.—Full-length views of the soft palate retractor.



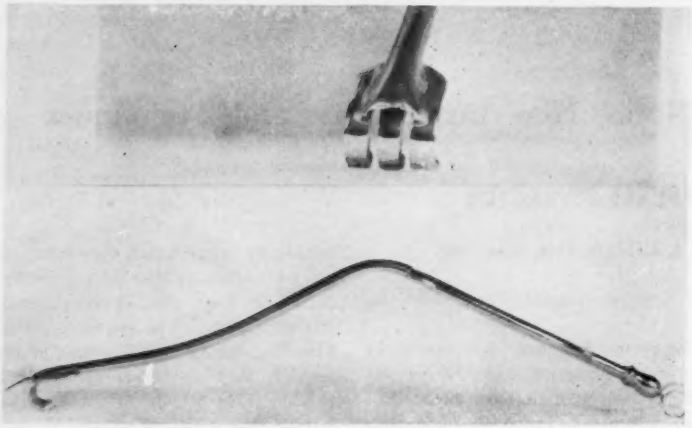


Fig. 2.—Close-ups of the soft palate retractor.

müller groove without interference from the uvula. The enlarged folds can be visualized, allowing us to complete the work and clean out all the tissues, using the punch forceps in addition to the adenotomes. As with any new instrument, practice is required to obtain satisfactory results, gentle handling being the main requisite. The instrument is also furnished with a suction tube.

The instrument is distributed by Cochrane Physician's Supplies, Inc., 133 E. 58th St., New York.

124 E. 84th St.

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SPECIAL INTRABRONCHIAL CATHETERS

ERNEST B. EMERSON Jr., M.D., Rochester, N. Y.

The rapid progress of thoracic surgery in recent years, especially the development of the segmental resection technique, has increased the problems of the bronchoscopist working as part of the thoracic team. Two main problems have made themselves evident, and the catheters and techniques herein presented have been developed to aid the bronchoscopist to satisfy the requirements of his contemporary in thoracic surgery.

The first problem is that of bronchograms when modern-day surgery demands a unilateral film or even a so-called spot bronchogram of one particular segment.

The second problem is that of obtaining suitable material for cytological study when that obtained at bronchoscopy may be unsatisfactory. The catheters make it possible to obtain specimens from the segment of the lesion without repeating the bronchoscopy, yet free of mouth contamination.

It is also possible to break up mucus plugs in the atelectatic patient under fluoroscopic guidance, even in the absence of a trained endoscopist.

THE CATHETERS

The catheters are a size No. 11 F., similar in all respects to ureteral demirigid catheters, except that the tips have been molded so that they will enter the upper lobes or middle lobe with ease under fluoroscopic guidance (Fig. 1). They are radiopaque and are marked to give the operator indication of depth of insertion before fluoroscopy is begun. Length is such that the manipulator's hands are well out of the direct range of radiation.

The size No. 11 F. was chosen on the basis of practical experience for two reasons: (1) Such a size reaches the necessary peripheral depth without damage to the lungs, and (2) It is impossible to flood the bronchus via such a catheter, even if an assistant handles the injecting syringe.

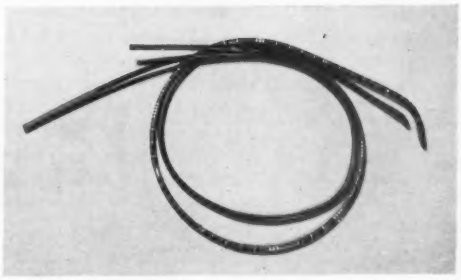


Fig. 1.—Special intrabronchial catheters. The one with the wider curve is for the upper lobe.

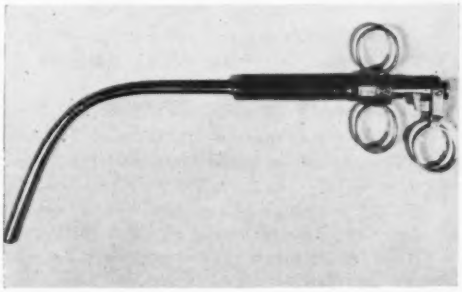
TECHNIQUE

The techniques are not difficult and will present no great problem to the trained endoscopist.

Anesthesia is accomplished, after suitable preoperative medication with pentobarbital (Nembutal), by spraying the throat with 1% tetracaine (Pontocaine). Thereafter intratracheal anesthesia is brought about by instilling 0.5% tetracaine into the trachea in a quantity not exceeding 6.0 cc.

The catheters are then passed into the trachea with the catheter gun (Fig. 2), which gives simple, positive, and nontraumatic entry by mirror without

Fig. 2.—Endotracheal catheter gun.



Submitted for publication Feb. 17, 1955.

From the Department of Surgery, Division of Otolaryngology, University of Rochester School of Medicine and Dentistry, in conjunction with the Bronchoscopic Service of the Batavia Veterans Hospital, Batavia, N. Y.

resorting to direct laryngoscopy.[1] Once the trachea is entered to the desired depth, and with a little practice, either the right or left main bronchus, segmental positioning of the catheters is accomplished by manipulation under the fluoroscope.

SUMMARY

The intrabronchial catheters are presented.

They have been found satisfactory for the purpose for which they were designed, i. e., the instillation of the iodized oil or water-soluble opaque material into the lung with a maximum of ease for the operator and a minimum of trauma for the patient.

Additional uses under fluoroscopic guidance include the obtaining of additional specimens for cytology direct from the segment involved and the breaking-up of mucus plugs in the patient with massive atelectasis in the absence of a trained endoscopist.

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Abstracts from Current Literature

Ear

CHLORAMPHENICOL-BORIC ACID POWDER IN THE TREATMENT OF OTITIC INFECTION. PAUL P. HEARN, Ann. Otol. Rhin. & Laryng. **63**:310 (June) 1954.

Hearn treated 69 patients (95 ears) with diffuse otitis externa, chronic suppurative otitis media, and infected radical or modified radical mastoidectomy cavities with chloramphenicol-boric acid powder (1 : 4). Initially, and at the time of each subsequent examination of treatment, the affected ears were carefully cleansed and dried before any medication was used. The chloramphenicol-boric acid powder (1 : 4) was insufflated. The patients were treated every four to five days, except in the severe acute cases of otitis externa, where treatment was more frequent. In some acute cases, roentgen therapy was used. Also, low-dose Staphylococcus toxoid was administered. For home use, 10% boric acid in Anhydrous Lanolin was prescribed. In cases of chronically infected radical mastoidectomy cavities and chronic suppurative otitis media, granulation tissue was curetted or cauterized with trichloroacetic acid before insufflation of the powder. The patient, in this instance, was not discharged until the ear had been free of discharge for a month.

If, during therapy, considerable improvement did not occur after the first treatment, cultures were obtained and sensitivity tests requested. The results of cultures were in agreement, in the main, with the more recent reports in the literature.

In 89 of 95 infected ears (representing 69 patients), the ears became dry. Improvement was noted in three ears. No change or failure of improvement was noted in three ears. In 17 of the cases of acute external otitis, the ears became dry. In 57 of the cases of chronic otitis externa, dry ears were secured. In all patients (12 ears) with chronic suppurative otitis media with central perforations, the ears became dry and clean. No improvement was noted after treatment in one case of chronic suppurative otitis media with a marginal perforation. In three of four patients with infected radical or modified radical mastoidectomy cavities, the ears became dry and clean.

Based upon this series, Hearn concludes that chloramphenicol-boric acid powder mixture (1 :4) when used in the treatment of the otitic infections studied in this report have the following favorable features: (1) desirable acidity (pH 4.0), (2) potent broad-spectrum antibiotic activity, and (3) freedom from undesirable side-effects.

STEELE, Kansas City, Kan.

RETROPHARYNGEAL ABSCESS AS A COMPLICATION OF ACUTE MIDDLE EAR INFECTIONS. M. J. TAMARI and J. F. ORRICO, Eye, Ear, Nose & Throat Month. **33**:523 (Sept.) 1954.

Retropharyngeal abscess is reported as a postoperative complication in two infants with middle-ear and mastoid infections. The children were only 3 and 4 months old, respectively, at the onset of the infection, and the spread of the infection toward the pharynx in both cases was probably induced by progression of the inflammation along the bony and cartilaginous wall of the Eustachian tube. Both cases are reported in detail.

JENNES, Waterbury, Conn.

THE "PEDIATRIC EAR" AND ANTIBIOTICS. ROBERT HENNER, Eye, Ear, Nose & Throat Month. **33**:530 (Sept.) 1954.

Sound otologic care seeks not only to heal a middle-ear infection and prevent intracranial complications but also to cause a return of normal hearing. All cases of acute otitis media should be treated with antibiotics.

Henner preferred the oral administration of penicillin because it may be administered over a long period of time, with relatively few side-reactions. This treatment must be continued over a prolonged period until the ear drum and the hearing are completely normal. The usual time for complete resolution is from 7 to 10 days but may extend to three or four weeks. Paracentesis is indicated if the ear drum remains thickened and swollen with bulging and if reduced hearing persists. The incidence of paracentesis should be less than 10%. In persistent cases, bacterial sensitivity tests are valuable. Mastoidectomy is indicated if symptoms indicate complications or if there is evidence of extension of the disease.

In cases of recurrent otitis media, the causative factors must be determined. The commonest cause is inadequate treatment of each acute attack. In cases such as this in which the x-ray examination does not reveal extensive destruction and in which no complications are present, the patient should be given intensive antibiotic therapy for three to four weeks. If recurrence develops again, complete mastoidectomy is indicated.

A search must be made for causative factors, such as enlarged adenoids, nasal allergy, or sinusitis. Recurrent acute disease may be simulated by attic lesions with cholesteatoma formation. The repeated acute exacerbations of chronic otitis media are surpressed with antibiotics, but the cholesteatoma continues to develop and may involve vital structures. Atticomastoidectomy is indicated in such cases to prevent loss of hearing and extension of the disease.

JENNES, Waterbury, Conn.

DIAGNOSIS OF CHOLESTEATOMA OF MIDDLE EAR. HANS BRUNNER, Eye, Ear, Nose & Throat Month. **33**:665 (Nov.) 1954.

The diagnosis of cholesteatoma is seldom difficult when there is a total destruction or a marginal perforation of the drum accompanied by a foul discharge. The diagnosis is, however, most frequently missed in epitympanal cholesteatoma. The term "silent cholesteatoma" has been applied to these cases by Henner and Tamari. The cholesteatoma is not actually silent, but the symptoms are masked.

Three cases are described in detail. In the first patient the scar in Shrapnell's membrane was not recognized during the quiescent periods, and at other times an external otitis masked the involvement of the middle ear. An x-ray examination would have permitted an earlier recognition of the cholesteatoma. In the second case the principal symptom was a persistent hemorrhage from the right ear with the history of similar episodes over a period of 10 years. There was a perforation in Shrapnell's membrane filled with cholesteatoma. An x-ray examination also pointed toward this diagnosis. In the third case a cholesteatoma occurred six years after a head injury, and without evidence of frank suppuration of the ear. In a period of three years the destruction due to the cholesteatoma caused the equivalent of a modified radical mastoid operation.

"Nature's radical operation" is a well-known clinical entity and is the only spontaneous definite cure of a cholesteatoma. In this case nature had performed a modified radical mastoid operation rather than a complete radical mastoid operation. This indicates that the modified radical mastoid operation is the proper treatment of epitympanal cholesteatoma.

JENNES, Waterbury, Conn.

DEAFNESS, HEAD INJURY, AND THE MEDICO-LEGAL EAR. M. REESE GUTTMAN, Eye, Ear, Nose & Throat Month. **33**:734 (Dec.) 1954.

Deafness following head injury without skull fracture often presents a diagnostic problem, especially in persons beyond 40 years of age. Presbyacusis is difficult to evaluate in such a case unless there has been prior audiometric examination. The head injury with basal skull fracture with a definite and confirmed history of bleeding from the ear and rupture of the ear drum and x-ray evidence of fracture of the temporal bone presents no problem.

The otologist has a difficult problem in the medicolegal situations created by the claim of deafness resulting from nonfracturing head injury. There must be a very careful search for possible past occurrence of other causes of nerve deafness unrelated to the injury, and there must be a recognition of the possibility of psychogenic deafness and also of simulation. The malingerer is usually not difficult to detect because only rarely is a bilateral total deafness claimed. Interval audiometry at intervals of one or more days is a satisfactory and precise method of establishing the presence and degree of deafness as well as in detecting simulation.

JENNES, Waterbury, Conn.

THE PATHOLOGY OF RUBELLA DEAFNESS. JOHN LINDSAY and R. SPENCER HARRISON, J. Laryng. & Otol. **68**:461 (July) 1954.

The production of fetal abnormalities depends more upon the timing and magnitude of the interference than the precise nature of the organism or agent. The same type of abnormality is producible by several methods—at least experimentally—provided they are applied at the same

developmental stage, and it appears that for each part of the body there is a critical developmental period during which it would be selectively affected.

After the sixth week of pregnancy the vestibular system is spared. Between the 6th and the 12th week the cochlea appears to be more easily damaged; the organ of Corti is not completely developed until the end of the 5th month.

In Goodhill's series of 904 deaf children, rubella deafness was responsible for 20.5% as against 3% caused by erythroblastosis and 10% by meningitis.

Significant pathology in structures involved is infrequently demonstrable. The bony labyrinthine capsule is always normal, as is the utricle and semicircular canals. Reissner's membrane, the stria vascularis, saccule, and tectorial membrane all show marked, if variable, changes. The cells of the spiral ganglion and Corti's organ are usually well preserved. The hair cells, however, are probably particularly affected by the lack of development in the apical regions, although this is difficult to demonstrate.

The changes in the cochlear duct appear to be secondary to changes in the stria vascularis. This latter structure may show considerable atrophy without any effect on hearing.

There is no evidence to indicate that hydrops ever occurs in these ears. It is difficult to explain the limitation of the changes to the cochlear duct and saccule.

LE JEUNE and NORMANN, New Orleans.

Pharynx

EFFECT OF VITAMIN K COMPOUND (SYNKAYVITE) ON COMPUTED BLOOD LOSS DURING ADENOTONSILLECTOMY. JAMES T. KING, Ann. Otol. Rhin. & Laryng. **63**:1029 (Dec.) 1954.

King evaluates the effect of vitamin K compound (Synkayvite) on the amount of blood lost during adenotonsillectomy by comparing the blood loss in two groups of patients undergoing the operation. One group (85 children) received 5 mg. of Synkayvite orally three times a day for one week preceding the operation, while the other group (91 children) did not. The operative technique was the same in both groups, as was the preanesthetic medication. Utilizing measured amounts of water for flushing suction tubing and washing instruments, as well as careful estimation of blood content of soaked sponges, a reliable determination of actual blood loss in each case was possible.

The average blood loss in the patients receiving Synkayvite was 53 cc., while the average loss in the untreated group was 51 cc. It was concluded that oral preoperative administration of Synkayvite did not significantly affect the computed blood loss during adenotonsillectomy in 176 children treated by the author.

STEELE, Kansas City, Kan.

PREGNANCY TUMOR OF THE TONGUE. LOUIS WEINSTEIN, Eye, Ear, Nose & Throat Month. **33**:532 (Sept.) 1954.

An unusual case is presented of a tumor of the tongue which gradually increased in size for three and a half months in a woman in her fifth month of pregnancy. There was a history of a similar tumor in two former pregnancies, the tumor disappearing without treatment in each case. An excision biopsy showed a mass 2 cm. in diameter and 1.5 cm. in height, and section revealed a lobulated mass covered with a thin layer of squamous epithelium occasionally hyperplastic in character. The tumor consisted of capillaries and small venous vessels puffed up with red blood cells in a loose mass of connective tissue resembling granulation tissue. This rich vascular tumor was described pathologically as a hemangioma gravidarium.

JENNES, Waterbury, Conn.

THE TONSILS IN ADVANCED AGE. GEORGE KELEMEN, Eye, Ear, Nose & Throat Month. **33**:723 (Dec.) 1954.

Involuntary changes in the palatine tonsils with regression of the size of the tonsils proceed until the sixth decade, when a period of high tonsillar activity can be noted. There is even possibly a slight enlargement of the organ and increase of the complaints. Operation on tonsils in persons of advanced age carries with it no greater operative risk than in younger persons. There is no reason to withhold the benefits of tonsillectomy because of advancing years. Microscopic examination reveals that involution in the palatine tonsils is a process that is

quantitative in that cells decrease in number and tissues in size without actual degeneration. The main activity of the tonsillar tissue is in the secondary nodule. The tonsils generally do not attain involution during a lifetime and continue functionally active so long as any tonsillar tissue remains.

JENNES, Waterbury, Conn.

FURTHER EXPERIENCE WITH CLOSED FOSSA TONSILLECTOMY AND ITS ADVANTAGES. ERNEST B. EMERSON JR., Eye, Ear, Nose & Throat Month. **34**:37 (Jan.) 1955.

Emerson describes his technique of closed fossa tonsillectomy and plastic closure of the tonsil wound. Five case reports are presented of tonsillectomy accomplished without hemorrhage in known bleeders. In two patients tonsillectomy was performed by the closed fossa technique without plastic closure of the tonsil wound, and in the other three the combined technique was used. Complete reliance was placed on the operative technique, with no attempt to reduce either bleeding or clotting time.

ABSTRACTOR'S COMMENT: Three of these patients, who were children, underwent adenoidectomy as well as tonsillectomy. One therefore may question the rationalé of considering any technique for tonsillectomy sufficient reason to perform both tonsillectomy and adenoidectomy in a patient with hemorrhagic tendencies without attempting to reduce such tendencies. Since the possibility of postadenoidectomy hemorrhage has not been altered, there is no reason for complacency in the surgical approach to these patients.

JENNES, Waterbury, Conn.

THE PROBLEM OF TONSILS. R. POCH VINALS, Arch. pediat. Barcelona **4**:439 (Jan.-Feb.) 1954.

The author reviews the problems of tonsil and Waldeyer ring infections and comes up with the following conclusions.

1. The tonsils and the entire group of adenoidal tissue composing Waldeyer's ring have a function in antibody formation.

2. This is a double function in which the tonsils assist the phagocytic and reticuloendothelial system on the one hand and the lymphocytes on the other.

3. So-called hematogenous infections of Waldeyer's ring are completely understandable as a fixing agent rather than an eliminating system for infections. In spite of the frequency with which tonsils are affected in hematogenous infection, these infections arise from the outside, not within the tonsillar tissue.

4. The cryptic nature of the tissue gives a favorable place for antibody formation.

5. The formation of antibodies to combat agranulocytic infections is a normal part of the tonsil function.

6. It appears that eventually tonsillar tissue will be found to have a function in the elaboration of proteins. Globulins are found around lymphoid follicles. The globulins are certainly abundant in tonsillar lymphosarcomas. The equilibrium between infection and immunity gives rise at times to the production of true centrofollicular granulomas.

7. The endothelial capillary inflammation explains in large part the symptoms associated with tonsillitis.

ALLEN, Santa Fe, N. Mex. [A. M. A. AM. J. DIS. CHILD.].

Larynx

TRACHEOTOMY: INDICATIONS AND COMMENTS. G. S. FITZ-HUGH and W. C. MORGAN JR., Eye, Ear, Nose & Throat Month. **33**:659 (Nov.) 1954.

The results of a study of 150 patients undergoing tracheotomy are presented with an analysis of the indication for which the procedures were performed. The following classification of the indications for tracheotomy is utilized: (1) fixed obstruction to upper airway (rapid obvious anoxia), (2) fluid obstruction to lower airway (slow obscure anoxia), and (3) prophylactic (to prevent 1 and/or 2).

The first group includes those patients with an obstruction at the laryngeal level of the air passage which could be bypassed by an opening in the trachea below the obstructive level, and represents the classical indication for tracheotomy.

In the second group the fluid mechanical obstruction may be caused by excessive accumulation of fluid material in the tracheobronchial tree from aspiration of oral fluids, hyperfunction

of the secretory elements, or failure of the cough mechanism from various causes. In this group postural drainage, bronchoscopic and catheter aspirations, and aspiration by way of an endotracheal tube may give relief, but frequently tracheotomy becomes the procedure of choice. This fluid obstruction may occur in a variety of diseases and injuries, including trauma to the chest, neck, head, spinal column, postoperative neurosurgical conditions, poliomyelitis, and tetanus.

With a better understanding of the clinical physiology of respiration and with greater experience in those diseases described in the second group, prophylactic tracheotomy is being performed more and more frequently. The establishment of a temporary airway by the insertion of an endotracheal tube or a bronchoscope transforms a disorderly, emergency type of tracheotomy into an orderly procedure. The vertical midline incision is used most often, but has little advantage over the horizontal incision, except in a true emergency. When the tracheal cartilage is incised, it is advisable to excise a small segment of the cartilage. Recently a plastic cannula has become available which is especially useful in those patients receiving x-ray irradiation therapy over the area of the tracheotomy. Fitz-Hugh and Morgan stress the fact that tracheotomy performed by skilled personnel is a surgical procedure involving little risk.

JENNES, Waterbury, Conn.

THE ROENTGEN DIAGNOSIS OF NONOPAQUE FOREIGN BODIES IN THE BRONCHI. FREDERICK ELIAS, New York J. Med. **55**:1461 (May 15) 1955.

Elias states that fully 50% of all foreign bodies aspirated are nonopaque and occur chiefly in children under 3 years. Two cases are cited to uphold this thesis. History is of first importance, but may not be elicited. There are coughing and difficult breathing following sudden onset. Wheezing is common. There may be a "symptomless interval" (Jackson and Jackson). Physical examination tells little, but there is a limitation of lung expansion on the affected side with an associated emphysema or atelectasis. Obstructive emphysema in a young child points to foreign-body suspect. Confusion with bronchopneumonia, unresolved pneumonia, tuberculosis, lung abscess, bronchiectasis, and laryngotracheobronchitis is not unlikely. Early x-ray diagnosis is paramount in order that removal of the foreign body be prompt before pathological changes take place in the lower airways. Vegetable matter (peanuts) produces severe symptoms, which often are completely masked. Jackson has called frequent attention to peanut brittle when inhaled by small children as a concomitant cause. The important item is to hold under foreign-body suspicion all small children with symptoms and signs of lower respiratory obstruction.

I. W. VOORHEES, New York.

Nose

SURGICAL TIPS ON THE NASAL TIP. IRVING B. GOLDMAN, Eye, Ear, Nose & Throat Month. **33**:583 (Oct.) 1954.

Common problems in rhinoplasty include the bulbous tip, the asymmetric tip, and the postsurgical "pinched-in" nostril. A bulbous tip with redundant thick and oily type of skin often presents a problem of a concave break in the dorsum after healing. Insertion of a thin dorsal graft extending from just above the tip to the glabella will produce a more uniform dorsum and improve the appearance of the tip. If the inserted thin graft eventually disappears, it is replaced by a thin layer of fibrous tissue, and the nasal dorsum remains unbroken with a straight profile line.

The asymmetric tip may be caused by caudal deflection of the septum, dislocated anterior nasal spine, unequal mesial crura, and post-traumatic scarring. An inherent skin factor causes uneven nostrils and lack of symmetry of the tip even after restoration of the basic deformity. Supplemental scaffolding is necessary for correction. The insertion of a triangular batten cut obliquely at its base will overcome this difficulty. The high point of the angulated batten is in contact with the lower leveled nostril, thus elevating the skin above it, with resulting symmetrical nostrils.

The postsurgical "pinched-in" nostrils are corrected by delivering the lower lateral crus on one or both sides and, after freeing it of scar tissue, suturing a piece of autogenous or preserved cartilage to the caudal margin of the lateral crus, one-half of which is left bare projecting mesially, so that when the crus is replaced in the nostril, the bare cartilage finds a bed in the lobule.

JENNES, Waterbury, Conn.

CORRECTIVE NASAL SURGERY IN CHILDREN: GOLDMAN TECHNIQUE. MILTON L. JENNES, Eye, Ear, Nose & Throat Month. **33**:586 (Oct.) 1954.

The application of rhinoplastic principles and technique is gradually freeing corrective surgery of the nasal septum from previous erroneous concepts. This is particularly true in respect to deformities involving the caudal part of the nasal septum. The very multiplicity of techniques used to correct these deformities is but other evidence of the confusion that has beset this kind of surgery. An essentially simple technique utilizing the rhinoplastic approach, which was devised by Dr. Irving B. Goldman, of New York, to correct deformities of the caudal end of the septum, has been the basis for the present work in corrective surgery of the nose and septum in children. A modification of the septal technique, suggested by Dr. Goldman for use in children, has been used in two children with obstructive caudal septal deformities, with highly satisfactory results.

AUTHOR'S SUMMARY.

USE OF REFRIGERATED HOMOGENOUS BONE GRAFT FOR MICROGENIA IN THE MAXILLO-FACIAL TRIAD. IRVIN J. FINE, Eye, Ear, Nose & Throat Month. **33**:591 (Oct.) 1954.

The "maxillo-facial triad," as described by Goldman, consists of a crooked nose with caudal septal deformity, a high-arched palate with malocclusion, and microgenia. A case is presented with successful correction of the nose and chin by means of rhinoplasty and the insertion of homogenous cancellous preserved bone in the chin between the mandible and soft tissues.

JENNES, Waterbury, Conn.

USE OF OX CARTILAGE IN RHINOPLASTY. WILLIAM SCHWARTZ, Eye, Ear, Nose & Throat Month. **33**:593 (Oct.) 1954.

Ox cartilage is valuable in filling in defects of the nasal dorsum, especially if the areas are not too deep, because the fibrous-tissue replacement of the graft restores the desired contour. The bed in the nasal dorsum must be carefully prepared, and the graft must be fixed in place carefully by the external dressing. Nine cases are presented in which dorsal ox cartilage grafts have been successful. In 49 cases in which bovine grafts were used as columellar struts and battens, the graft was absorbed in each case. Although there was fibrous replacement, the sharpness of the contour of the tip profile was lost. Ox cartilage is very satisfactory as a chin graft in microgenia because the fibrous replacement adequately eliminates the defect.

JENNES, Waterbury, Conn.

HEMANGIOMA OF NASAL BONE. SAMUEL M. BLOOM, Eye, Ear, Nose & Throat Month. **33**:596 (Oct.) 1954.

A case is presented of hemangioma of the nasal bone following trauma. Biopsy was followed by radiotherapy and surgical excision. The resultant depression was repaired by the insertion of a preserved homogenous bone graft, followed by complete healing.

JENNES, Waterbury, Conn.

EFFECT OF BIOMYDRIN ON THE NASAL MUCOSA OF ALLERGIC PERSONS DURING THE 1953 RAGWEED POLLINATING SEASON. M. A. KAPLAN, A. L. AARONSON, and M. GOLDIN, Eye, Ear, Nose & Throat Month. **33**:731 (Dec.) 1954.

Biomydrin, an antibiotic, antihistamine, and decongestant nasal solution, was used in 135 allergic patients with active nasal symptoms from ragweed hay fever. The authors cite general agreement of the patients as to symptomatic relief and find no evidence of sensitization to the ingredients. It is significant that there was little or no correlation between the severity of the clinical symptoms, the appearance of the nasal mucosa, the cytology, and the cultural findings. No major changes were noted in the bacteriology or cytology of nasal smears or cultures taken at the beginning, in the middle, and after the end of the pollinating season.

JENNES, Waterbury, Conn.

Miscellaneous

THE USE OF STAPHYLOCOCCUS TOXOID IN OTOLARYNGOLOGY. FRENCH K. HANSEL, Ann. Otol. Rhin. & Laryng. **63**:324 (June) 1954.

Hansel has found Staphylococcus toxoid effective in the treatment of furunculosis of the ear canal and vestibule of the nose; seborrheic dermatitis of the auricles and face; acute respiratory infections; contact and atopic dermatitis of the auricle, periorbital area, and nasal vestibule; urticaria and angioedema of the lips, tongue, pharynx, and larynx; serum disease reactions following the administration of penicillin; lowered immunity resulting from antibiotic administration. The best approach to such problems is through a correlation of bacteriologic, immunologic, and cytologic study. In utilizing Staphylococcus toxoid, maximum effectiveness is dependent upon the establishment and maintenance of an optimum small dosage. In general, the effective doses are found below that which causes a focal reaction. The principles of optimum dosage are applicable in the use of other bacterial or virus vaccines, as well as a variety of other antigenic and allergenic agents. Any increase or decrease is made only with the idea of maintaining the effective range; no progressive build-up of dosage is recommended. Following these principles, general or constitutional reactions are rare.

The author advises against the widespread use of antibiotics, as there is evidence to show that antibiotic therapy tends to decrease the production of antibodies and lower natural immunity. On the other hand, low-dose Staphylococcus vaccine therapy tends to establish or stimulate natural immunity in certain diseases. However, in some instances combined vaccine therapy with minimum doses of antibiotics may be advisable.

STEELE, Kansas City, Kan.

HEMOPTYSIS: REPORT OF MASSIVE HEMORRHAGE WITH NEGATIVE LUNG FINDINGS. HARRY MEYERSBURG, Eye, Ear, Nose & Throat Month. **34**:49 (Jan.) 1955.

Massive blood spitting may originate in the hypopharyngeal region, which has a very rich blood supply and where varices are not uncommon. Spontaneous bleeding from such vessels may be so profuse as to alarm the patient and may cause severe anemia. Meyersburg reports two cases of massive hemorrhage in which x-ray examination of the chest was normal. In both the site of bleeding was found to be a vein in the right vallecula. The treatment consisted in cauterization with bichloracetic acid, followed by the application of Heavy Mineral Oil to limit the spread of the acid. Salivation was controlled by the prior administration of atropine sulfate in order to control salivation, to avoid the entry of acid or oil into the larynx.

ABSTRACTOR'S COMMENT: A case was recently observed which was very similar to the two described in this article. The patient was a middle-aged woman with massive hemorrhage in whom a previous work-up, including chest x-ray, bronchoscopy, and bronchography, had disclosed normal findings. The site of bleeding was found to be large tortuous veins in both valleculae. Dr. Meyersburg is quite correct in his observation that the bleeding from such vessels can be quite profuse.

JENNES, Waterbury, Conn.

MEDICINE'S IMPORTANCE IN AVIATION. KENNETH L. STRATTON, New York J. Med. **55**:1129 (April 15) 1955.

Dr. Stratton is Medical Director of the American Airlines, Inc., at La Guardia Field, N. Y. He has written an exceptionally comprehensive article, which should be read by every practitioner regardless of his field, since almost everyone flies these days at some time in life, and problems continually arise before, during, and after flight. In 1931 the School of Aviation was moved to Randolph Field, Texas, where many ENT men served. Pilots must be examined and tested at frequent intervals, for much depends on the condition of ears, nose, and throat as to "lay-off" or continued service. For example, aerotitis media or barotitis with closure of the Eustachian tube and pain in the ears is common. Fortunately, simple inflation of the tubes usually suffices to clear the condition, but if there is acute respiratory infection (a cold), one should not fly until the condition is cleared. This is especially true of pilots, but passengers may not be too much disturbed under the modern pressurized cabin conditions, where simulated atmospheric ground environment is sought. This pressurization has materially reduced "air sickness" and also aerotitis. In World War II the Army was very strict in admitting would-be pilots to

service. Nose, throat, and ear conditions had to be nearly perfect. Deviated septa, sinusitis, and bad tonsils had to be corrected before a candidate could be taken in for training. Dr. Stratton has had very great experience in aviation medicine, and, fortunately, he is a gifted writer.

I. W. VOORHEES, New York.

ARTIFICIAL FEVER TO AID PENICILLIN IN CHRONIC SINUSITIS AND CHRONIC OTITIS MEDIA. MAX UNGER, New York J. Med. **55**:1470 (May 15) 1955.

Unger states that penicillin was introduced to the medical profession some 10 years ago with definite limitations as to its use: chiefly in Gram-positive infections and in some Gram-negative ones. After brilliant success with this new "miracle drug," physicians began to use penicillin in cases which were not adapted to its administration, for example, in certain walled-off lesions, such as osteomyelitis, appendicitis, and empyema. For a similar reason it did not work in patients with chronic ear and sinus conditions, but there was some improvement where acute exacerbations with fever were at hand. Therefore, Unger thought that it might be good experimental medicine first to produce a fever with antityphoid vaccine. Advantages were (1) the antibiotic action of penicillin in the presence of fever and (2) the phagocytic action created by the protein in the antityphoid vaccine. The author's present plan is to give the vaccine subcutaneously, produce fever, then give penicillin in 600,000 units once daily so long as seems necessary. This article reports an over-all survey of 20 cases of chronic sinus and ear conditions, with much improvement in all and no troublesome complications. The patients remain ambulant (not required to go to bed). But they must cut down all fluids, especially coffee, cocoa, and tea. This is done in order to maintain as high a level of penicillin in the blood as possible and to slow the kidney elimination rate. Several tables are given to show the detailed history of each patient.

I. W. VOORHEES, New York.

DIFFICULTIES IN SWALLOWING IN CHILDREN. P. MOUNIER-KUHN and A. PERSILLON, Pédiatrie **10**:37, 1955.

This very thorough review of the subject, illustrated by 15 x-ray reproductions and numerous case reports and documented by three pages of references of the world literature, is divided into three parts.

The first part presents briefly the anatomical and physiological conditions necessary for the act of swallowing. The second part discusses swallowing disturbances in the infant. Physiologically, each infant must develop the reflexes and coordination of the various phases of swallowing, and this period of learning may be delayed, as demonstrated by the case of a premature girl 12 to 15 days of age who at first was believed to have tracheoesophageal fistula. The true disturbances in this age group are divided into those caused by malformations and anomalies of the gastrointestinal tract as well as the central nervous system, infections or tumors affecting the process of swallowing directly or indirectly, nervous disturbances, such as anorexia nervosa, spasms of the esophagus, meningeal hemorrhages, or the effect of drugs, and accidental disturbances, such as foreign bodies.

The third part presents swallowing difficulties in the older child, such as those produced by infections causing paralysis of the palatopharyngeal muscles due to diphtheria, or those on a nervous basis (poliomyelitis, Guillain-Barré's syndrome, dermatomyositis, tumors affecting the brain stem, and encephalopathies). An important group includes pathological changes of the esophagus itself, such as stenosis of the esophagus of delayed appearance, compression from without, spasms, megaesophagus, varicose veins, diphtheria of the esophagus, thrush, peptic ulcer, stenosis as a result of corrosive burns, and foreign bodies.

GLASER, Baltimore [A. M. A. AM. J. DIS. CHILD.].

Directory of Otolaryngological Societies *

FOREIGN AND INTERNATIONAL

Canadian Otolaryngological Society
(Société Canadienne d'Otolaryngologie)

President: Dr. G. Edward Tremble, 1390 Sherbrooke St. West, Montreal.
Secretary: Dr. G. Arnold Henry, 170 St. George St., Toronto.
Place: Bigwin Inn, Lake of Bays, Muskoka, Ont.

International Bronchoesophagological Society

President: Dr. Antonio da Costa Quinta, Lisbon, Portugal.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Fourth International Congress of Bronchoesophagology.
Place: Buenos Aires, Argentina. Time: Oct. 28-29, 1955.
President of Congress: Dr. Antonio Carrascosa.

International Congress of Audiology

Place: Leyden, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

International Course in Paedo-Audiology

Place: Groningen, Netherlands.
General secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

Pan-American Association of Oto-Rhino-Laryngology and Broncho-Esophagology

President: Dr. Juan Manuel Tato, Azcuenaga 235, Buenos Aires, Argentina.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Fifth Pan-American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology.
Place: San Juan, Puerto Rico. Time: April 8-12, 1956.
President of Congress: Dr. Juan H. Font, Medical Arts Building, San Juan.

Sixth International Congress of Otolaryngology.

President: Dr. Arthur W. Proetz, 3720 Washington Blvd., St. Louis.
General Secretary: Dr. Paul H. Holinger, 700 N. Michigan Ave., Chicago 11.
Place: Hotel Statler, Washington, D. C. Time: May 5-10, 1957.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. John R. Lindsay, Chicago.
Secretary: Dr. Hugh A. Kuhn, 112 Rimbach St., Hammond, Ind.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Algernon B. Reese, 73 E. 71st St., New York 21.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave., Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 9-15, 1955.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

AMERICAN BOARD OF OTOLARYNGOLOGY

President: Dr. Frederick T. Hill, Professional Building, Waterville, Maine.

Secretary-Treasurer: Dr. Dean M. Lierle, University Hospitals, Iowa City.

Place: Sheraton-Mount Royal Hotel, Montreal, Canada. Time: May 6-11, 1956.

AMERICAN BRONCHO-ESOPHAGOLOGICAL ASSOCIATION

President: Dr. Daniel S. Cunning, 115 E. 65th St., New York 21.

Secretary: Dr. F. Johnson Putney, 1719 Rittenhouse Sq., Philadelphia 3.

Place: Sheraton-Mount Royal Hotel, Montreal, Canada. Time: May 15-16, 1956 (afternoons only).

AMERICAN LARYNGOLOGICAL ASSOCIATION

President: Dr. Bernard J. McMahon, 8230 Forsyth Blvd., Clayton 24, Mo.

Secretary: Dr. Harry P. Schenck, 326 S. 19th St., Philadelphia 3.

Place: Seigniory Club, Montreal, Canada. Time: May 13-14, 1956.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President: Dr. Dean M. Lierle, Iowa City.

Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.

Place: Sheraton-Mount Royal Hotel, Montreal, Canada. Time: May 15-17, 1956 (mornings only).

SECTIONS:

Eastern.—Chairman: Dr. John A. Murtagh, Hanover, N. H.

Place: The Statler Hotel, Boston. Time: Jan. 13, 1956.

Southern.—Chairman: Dr. J. M. Robison, Houston, Texas.

Place: The Shamrock, Houston, Texas. Time: Jan. 27-28, 1956.

Middle.—Chairman: Dr. William H. Craddock, Cincinnati.

Place: The Netherlands Plaza, Cincinnati. Time: Jan. 16, 1956.

Western.—Chairman: Dr. David D. De Weese, Portland, Ore.

Place: County Medical Society Building, San Francisco. Time: Jan. 21, 1956.

AMERICAN OTOLOGICAL SOCIETY, INC.

President: Dr. William J. McNally, 1509 Sherbrooke St. West, Montreal 25, Canada.

Secretary-Treasurer: Dr. Lawrence R. Boies, 90 S. Ninth St., Minneapolis 2.

Place: Seigniory Club, Montreal, Canada. Time: May 11-12, 1956.

AMERICAN OTORHINOLOGIC SOCIETY FOR THE ADVANCEMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY, INC.

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Secretary: Dr. Louis Joel Feit, 66 Park Ave., New York 16.

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Place: Palmer House, Chicago. Time: 1955.

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* See page 662 AMA Archives of Otolaryngology, June 1955. For other instruments designed by Dr. Benito B. Rish refer to:
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February 1953, Vol. 57, pp. 206-209
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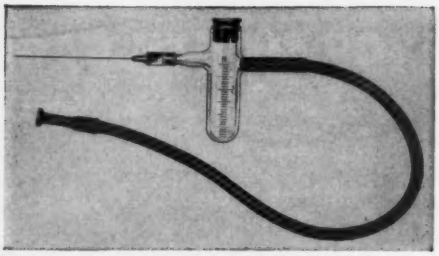

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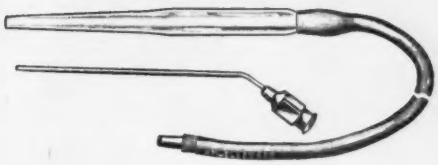

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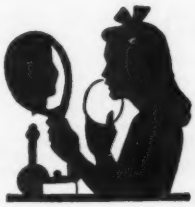

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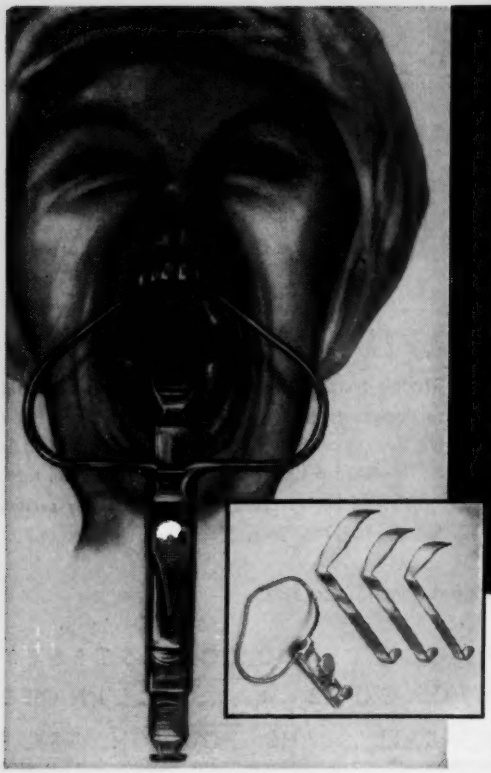

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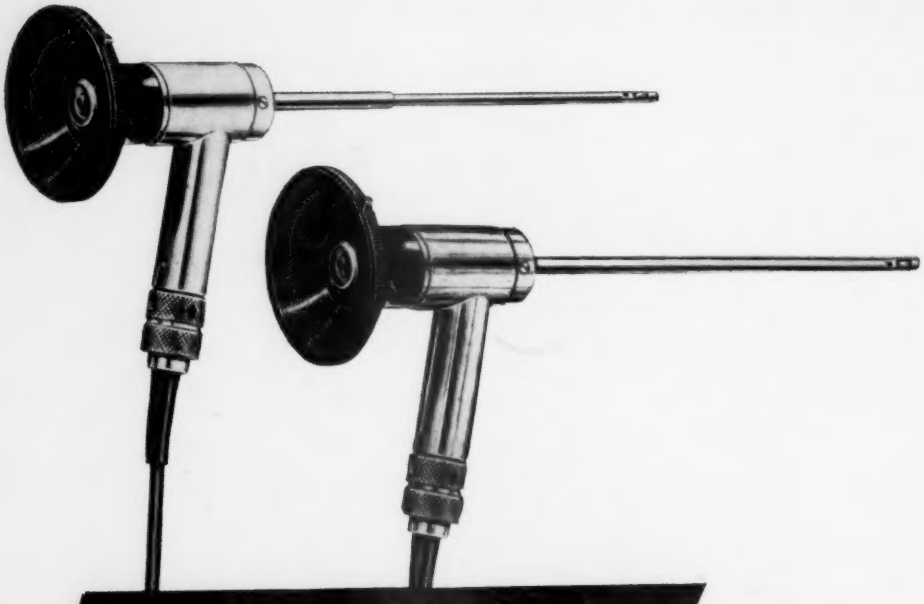

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